# SCIENCE

NOVEMBER 17, 1950





COMPLETE TABLE OF CONTENTS ON PAGE 3

VOLUME 112, NUMBER 2916

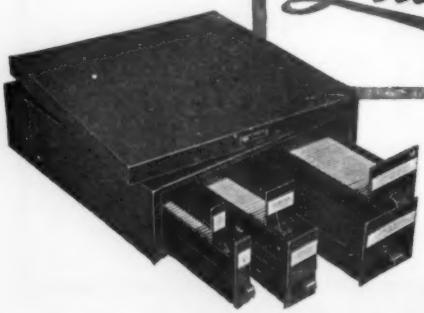
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

# 45% greater capacity... at lowest cost per-slide

*plus these exclusive "LAB-AID" features...*

- **EFFICIENCY** ... *slides, in single bank drawers, are easily inserted or withdrawn*
- **VISIBILITY** ... *single rows offer unobstructed visibility*
- **COMPACTNESS** ... *requires only nineteen-inch-square floor or desk space*
- **FLEXIBILITY** ... *interchangeable drawers file microslides, transparencies, lantern-slides, index cards.*
- **CONVERTIBILITY** ... *drawers quickly changed from spaced filing to close-packed storage, or vice versa.*
- **"SPRING-ACTION"** ... *flexible separators for spaced filing*
- **SAFETY** ... *slides can't be chipped in pulling out drawers: safety stop prevents accidental full withdrawal: all-steel fire-resistant construction*
- **SMOOTH OPERATION** ... *drawers won't stick or warp: slide freely on metal tracks*
- **EASY STACKING** ... *interlocking units permit stable stacking to any convenient height*
- **ALL-STEEL CONSTRUCTION** ... *welded steel throughout: great strength with minimum waste space*
- **ECONOMY** ... *storage cost per slide lowest ever!*

*A single LAB-AID unit-section, with two 1", two 2" and two 4" drawers. Unit for unit, space for space, LAB-AID offers unapproached flexibility and economy.*



## Lab-aid laboratory filing systems

THE TECHNICON COMPANY
215 E. 149 St., New York 51, N. Y.

Send me particulars of "LAB-AID" filing system.

Name.....

Address.....

City.....State.....

# SCIENCE

Vol. 112 No. 2916 Friday, November 17, 1950



## *Table of Contents*



SCIENCE, founded in 1880, is published each Friday by the American Association for the Advancement of Science at the Business Press, 10 McGovern Ave., Lancaster, Pa. Entered as second-class matter at the Post Office at Lancaster, Pa., January 13, 1948, under the Act of March 3, 1879. Acceptance for mailing at the special rate postage provided for in the Act of February 28, 1925, embodied in Paragraph (d-2) Section 34.40 P. L. & R. of 1948.

All correspondence should be sent to SCIENCE, 1515 Massachusetts Ave., N. W., Washington 5, D. C. The AAAS assumes no responsibility for the safety of manuscripts or for the opinions expressed by contributors. Four weeks' notice is required for change of address, and an address stencil label from a recent issue must be furnished. Claims for a missing number will be allowed only if received within 60 days from date of issue.

Annual subscriptions, $7.50; single copies, $.25; foreign postage, outside the Pan-American Union, $1.00; Canadian postage, $.50.

The AAAS also publishes THE SCIENTIFIC MONTHLY. Subscription rates on request.

RABBIT CAGE

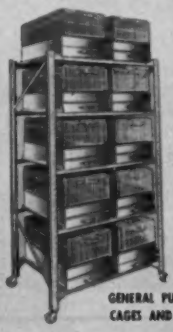
GENERAL PURPOSE CAGE

SMALL ANIMAL CAGE

AUTOMATIC WATERING SYSTEM ILLUSTRATED

SMALL ANIMAL RACK AND CAGES

CAT CAGE



GENERAL PURPOSE CAGES AND RACK

Bussey's "PERMAWELD"

# LABORATORY CAGES and EQUIPMENT

PAPER CLEANING SYSTEM ILLUSTRATED

## Laboratory Animal Equipment for your every need

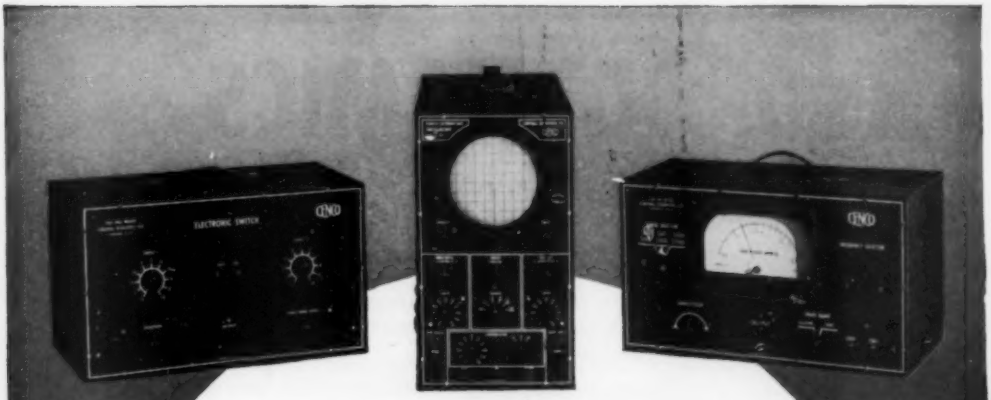
What's your problem? Is it housing a large number of laboratory animals in a limited space or finding that "special answer" to an unusual cage need? There is a Bussey cage and rack to end your search.

We make cages, racks, automatic watering systems or complete equipment for the housing and sanitary care of all laboratory animals. Bussey Products Co. offers complete cage units that assure maximum efficiency, compact sizes and minimum work for the user.

The improved "Permaweld" welded-wire construction is a result of top-notch engineering. Our modern production techniques permit price economy. The results can't be beat. Hundreds of the country's leading laboratories can tell you that.

Need help on a tough "special problem"? Our engineers will gladly assist you with any size and type of cage or rack to meet your special applications. Just write for our catalog or submit your specifications.

**BUSSEY PRODUCTS CO., 6000–19 W. 51st St., Chicago 38, Ill.**



The CENCO SINE WAVE AND SQUARE WAVE GENERATOR will produce both sine waves and square waves in the frequency range from 20–20,000 cps. This range is obtained in three steps selected by means of a range switch on the front panel of the instrument. The three ranges are from 20–200 cps., 200–2000 cps. and 2000–20,000 cps. The oscillator is calibrated with an accuracy of ±3% of the setting, or 3 cps.

The CENCO ELECTRONIC SWITCH permits the simultaneous observation of two or more separate signals on the screen of a cathode ray oscilloscope. A single electronic switch will allow two signals to be observed, while if two electronic switches are connected in cascade, three signals may be observed with but one oscilloscope. The electronic switch may be used to observe the input signal to an amplifier and the output signal from the same amplifier simultaneously on the same oscilloscope. Thus, wave form, amplitude and phase distortion of the amplifier may be quickly examined. The effects of added components to circuits, differentiation and integration of a square wave, and many other phenomena may be seen.

**No. 80592 Cenco Sine Wave and Square Wave Audio Oscillator . . Each $130.00**
**No. 80600 Electronic Switch Each $105.00**
**No. 71552 Cenco Cathode Ray Oscilloscope, 5-inch screen . . . . . Each $165.00**

*Write for circular*

**CENTRAL SCIENTIFIC COMPANY**

*Scientific* CENCO *Apparatus*

1700 IRVING PARK ROAD CHICAGO 13

NEW YORK BOSTON SAN FRANCISCO NEWARK LOS ANGELES TORONTO MONTREAL

# New Lamp Gives a Bargain in Sunshine

*A product of the Lamp Division, Westinghouse Electric Corp., Bloomfield, N. J.

Now sun lovers can bathe to their hearts' content, thanks to the new Fluorescent Sun Lamp* recently developed by Westinghouse.

Five times more efficient than any other sun lamp, with a life 4 times longer, this new discovery costs less to buy and less to use.

So inexpensive is it to operate that farmers are investigating its use in farm buildings. Preliminary studies show that benefits to poultry from the ultraviolet radiations it produces are: Increased egg production; larger eggs with greater Vitamin D content; stronger shells; greater hatchability of eggs; rickets in baby chicks eliminated; and increased rate of growth in small chicks and pullets.

In a test case still under way, the increase in egg production that has taken place was enough to pay for the sun lamp equipment in approximately three months.

While benefits obtained by calves, hogs and other farm animals have not all been determined, it is believed from experience so far that results will lead to extensive application of this lamp as a farm productive tool.

Westinghouse research pays many dividends. To industry, by developing cost-cutting equipment . . . to the public, by making available products that lead to better living . . . and by maintaining demand for its products that keep men and machines busy.

All of these things happen because so many people know . . . G-10103

**YOU CAN BE SURE..IF IT'S Westinghouse**

# Japanese Mining and Petroleum Industries: Programs under the Occupation[1]

Robert Y. Grant[2]

*Mining and Geology Division, Natural Resources Section*

*General Headquarters, Supreme Commander for the Allied Powers*

TO BRING ABOUT THE POST-HOSTILITIES RECOVERY of Japan's mining and petroleum industries to the extent required for the minimum needs of the economy and the avoidance of disease and unrest, the Mining and Geology Division, Natural Resources Section, General Headquarters, Supreme Commander for the Allied Powers, undertook the development of a program of technical advice and assistance. Later, as the policy of the Occupation was shifted to emphasize the economic rehabilitation of Japan, the technical assistance program assumed greater importance, not only for its benefits to the Japanese, but also for the United States in consequence of reductions in the cost of the Occupation made possible by increases in the output of mineral raw materials, as well as in the need for imports, purchased largely with United States funds.

In the development of the program, the basic consideration behind all the work of division technologists has been to help the Japanese engineer, metallurgist, or geologist solve his own problems. An attempt has been made to fit proposed solutions to the Japanese techniques or organizational patterns, rather than to introduce completely new methods and systems.

An adequate supply of minerals and mineral products is essential to support Japan's industrial economy. Although minerals supply both raw materials for construction and manufacture, and fuel for energy, they are also a basic requirement in the production of food. Approximately 1,800,000 metric tons of pyrites are mined annually, to furnish most of the sulfuric acid necessary for the manufacture of superphosphate and ammonium sulfate, two of Japan's principal fertilizers.

Although Japan produces many different minerals, few are mined in sufficient quantities to meet requirements. Part of the supply must be imported. Among major minerals, only the reserves of coal, pyrite, sulfur, and zinc suffice for production adequate to satisfy domestic demands; and although Japan's supply of steam coal is sufficient for her needs, her resources of special-purpose coal, such as coking coal, are not. Manganese and copper can be had in relatively large quantities, but to obtain an adequate supply would mean production from marginal mines at excessive costs. Reserves of lead are small, as are reserves of iron ore, the most vital raw material for an industrial economy. Even under conditions of reduced demand, less than 40 percent of Japan's iron ore is being extracted from domestic mines today. Some high-grade chrome and refractory chrome can be produced, but such alloying metals as nickel, cobalt, tungsten, and others needed in the iron and steel industries are produced only in small amounts. Minor amounts of asbestos are available. Of course clay is abundant, although some high-grade clay probably must be obtained from foreign sources. Building stone and other quarried products are plentiful, but glass sand must be imported to make up a deficit of almost 50 percent. Limestone, the second most important product of the mining industry from the standpoint of yen value, is available in quantities ample for the cement industry and for agricultural lime. One material in short supply is plaster-grade gypsum, though cement-grade gypsum is plentiful enough to supply the cement industry.

[1] Published by permission of the Chief, Natural Resources Section.

[2] Assistance in the preparation of this paper was received from L. W. Stach, J. F. Harrington, R. L. Kidd, C. S. Merriam, J. B. Lewis, Caleb Davies, Jr., A. H. Solomon, and other members of the staff of the Mining and Geology Division, National Resources Section, General Headquarters, Supreme Commander for the Allied Powers, all of whom provided material for the text, and assisted in preparing revisions of the final draft. Without the work of these men and their colleagues the record outlined herein would not have been possible. Reference must be made also to the contribution made to the record of the Division by Thomas A. Hendricks and Quentin D. Singewald, both of whom served as Chief, Mining and Geology Division, while on loan from the U. S. Geological Survey during the early days of the Occupation when many of the Division programs were initiated.

The petroleum produced in Japan is a scant 10 percent of her requirements. At the beginning of the Occupation, known reserves of petroleum were found to be small and undergoing rapid depletion. It is now believed, however, that additional reserves of petroleum can be found and that production can be raised, but in all likelihood Japan will always need to import a substantial amount of petroleum.

Programs leading to increased availability of mineral and metal raw materials have been emphasized by the Mining and Geology Division in its work with the agencies of the Japanese government and with mining companies. Coal, petroleum, and mineral exploration programs have been established. Mining and petroleum production methods are being studied and improved. Milling, beneficiation, and coal-washing systems are being refined and brought up to date to reduce losses in processing. Metallurgical methods are receiving careful attention so that the most efficient use possible can be made of Japan's raw materials, both in the production of metal and in the reduction of the amount of fuel used in the smelting and refining process, thereby saving coal for other uses. Improved technology, whereby raw materials of poor quality can be substituted for high-grade materials, is receiving attention. To insure long-range support of Japan's economy, the field of mineral policy is being studied, and the Japanese government is being advised on realistic mineral programs that will provide not only immediate production, but the discovery of ore reserves needed to support the long-term projects and the needs of the country.

## Mining Industry

Mining has been carried on in Japan since the mythological era. Although base metals were mined earlier, precious metals were first produced about A.D. 675–700. The growth of Buddhism stimulated copper production because of the need for copper in the construction of temples, images, and bells. In spite of the fact that many of Japan's larger mines were first opened 300–500 years ago, mining was not modernized until after the Meiji Restoration (1868). The mining industry received a great stimulus from World War I, and output was further increased prior to and during World War II.

Mining was, in common with most other industries, at a virtual standstill at the end of hostilities. Vigorous steps obviously were required to obtain production needed for industrial recovery. To provide a basis for planning, technologists of the Mining and Geology Division studied the mineral resources of the country, and a general report on mineral potential was published as Natural Resources Section Report No. 44. Subsequently 36 other reports on various minerals, as well as on the mining industry in general, were issued. Many of these reports were the work of geologists and engineers of the United States Geological Survey on loan to the division. At least 37 Survey technologists were assigned to the Natural Resources Section between October 2, 1945, when the Section was established, and January 1, 1948. Personnel from the United States Bureau of Mines also participated in work during 1946. Other studies were prepared on the resources of areas formerly occupied by Japan. Surveys are still being made, with 4 reports in press and several others in various stages of completion. A complete list of Natural Resources Section reports prepared by the Mining and Geology Division is presented herewith (Table 1).

TABLE 1

| Mineral Commodity Reports | Report or Preliminary Study No. |
|---|---|
| 1. Antimony Resources of Japan | 92 |
| 2. Asbestos Resources of Japan | 115 |
| 3. Barite Resources of Japan | 67 |
| 4. Cement Industry of Japan | 105 |
| 5. Chromite Resources of Japan | 64 |
| Suppl.: Descriptions of Chromite Producing Areas and Mines | |
| 6. Cobalt Resources in Japan | 54 |
| 7. Copper in Japan | 106 |
| 8. Dolomite Resources in Japan | 53 |
| 9. Fluorspar Resources of Japan | 75 |
| 10. Garnet Resources of Japan (prelim. study) | 7 |
| 11. Graphite Resources of Japan | 81 |
| 12. Iron Sand Resources of Japan | 98 |
| Suppl.: Descriptions of Iron Sand Mines | |
| 13. Iron Ore Resources of Japan | 69 |
| Suppl.: Descriptions of Iron Ore Producing Areas and Mines | |
| 14. Limestone, Lime, and Gypsum Resources in Japan | 60 |
| Suppl.: Descriptions of Gypsum Producing Areas and Mines | |
| Suppl.: Limestone Production and Consumption | |
| 15. Mercury Resources of Japan | 91 |
| 16. Mineral Resources of Japan Proper 1925–45 (prelim. study) | 44 |
| 17. Molybdenum in Japan | 72 |
| 18. Nickel Resources of Japan | 57 |
| 19. Pyrite Resources of Japan | 70 |
| 20. Pyrophyllite Resources in Japan (prelim. study) | 15 |
| 21. Radio-Grade Quartz Crystal Resources in Japan (prelim. study) | 9 |
| 22. Sulphur Resources of Japan | 66 |
| Suppl.: Descriptions of Japanese Sulphur Producing Areas and Mines | |
| 23. Talc Resources in Japan (prelim. study) | 30 |
| 24. Tungsten Resources of Japan | 77 |
| 25. Zinc-Lead Resources of Japan | 65 |
| Suppl.: Descriptions of Zinc-Lead Producing Areas and Mines | |
| *Mineral Commodity Reports in Production* | |
| 1. Minerals Resources of Japan | |
| 2. Fire Clay Resources of Japan | |
| 3. Gold and Silver in Japan | |
| 4. Ceramic Whiteware Raw Material Resources of Japan | |
| *Mineral Commodity Reports in Preparation* | |
| 1. Tin Resources of Japan | |
| 2. Bleaching Clays in Japan | |

3. Silica Resources in Japan .....
4. Platinum Group Metals Resources of Japan .....
5. Manganese Resources in Japan .....

MINING INDUSTRY REPORTS

1. Administration of the Japanese Mining Industry .. 6
2. Wartime Administration of the Japanese Mineral Industry ..... 17
3. Japanese Research Institutions in the Field of Mining and Geology ..... 41
4. Economic Controls in the Japanese Coal Industry .. 52
5. English-Japanese Terms, Mining and Petroleum Industry ..... 111
6. Mining Practices at Matsuo Pyrite Mine, Japan ... 114
7. Machinery Distribution in the Japanese Mineral Industry (prelim. study) ..... 14
8. Material Consumption in the Japanese Mining Industry (prelim. study) ..... 17
9. Materials and Power used in Nonferrous Smelting and Refining in Japan (prelim. study) ..... 32
10. Machinery Distribution in the Japanese Coal Mining Industry (prelim. study) ..... 20
11. Consumption of Expendable Materials by Japanese Coal Mines (prelim. study) ..... 8

METALLURGY REPORTS

1. Aluminum Metallurgy in the Japanese Empire .... 87
2. Electric Furnace for Smelting Low-Grade Ores in Japan (prelim. study) ..... 35
3. Experimental Smelting and Refining of Iron-Chromium-Nickel Ore in Japan (prelim. study) ..... 12
4. Ferroalloy Metallurgy of Japan ..... 62
5. Iron and Steel Metallurgy of the Japanese Empire 50
6. Lead Metallurgy in Japan ..... 83
7. Magnesium Metallurgy in the Japanese Empire ... 85
8. Metallic Manganese Metallurgy in Japan ..... 100
9. Tungsten and Molybdenum Metallurgy of Japan ... 61
10. Tin Metallurgy in Japan ..... 82
11. Zinc Metallurgy in Japan ..... 96

SOLID FUELS REPORTS

1. Basic Problems of the Coal Mining Industry in Japan ..... 3
2. The Coal Industry of Japan in Recent Years ..... 21
3. Low-Temperature Carbonization of Coal in Japan . 74
4. Ishikari Coal Field, Hokkaido ..... 99
5. The Coal Fields of Kyushu ..... 103
6. Lignite in Japan ..... 112
7. Coal Fields of Eastern Honshu, Japan ..... 120
8. Coke in Japan (prelim. study) ..... 2
9. Quality and Uses of Japanese Coal and Lignite (prelim. study) ..... 3
10. The Briquette Industry in Japan in 1947 (prelim. study) ..... 16
11. Utilization of Methane as Fuel in Japan (prelim. study) ..... 22

*Solid Fuels Reports in Production*

1. Coal Fields of Western Honshu, Japan .....
2. Small Coal Fields of Hokkaido .....

PETROLEUM REPORTS

1. Oil Fields of Hokkaido ..... 18
2. Japanese Petroleum Drilling Methods and Equipment ..... 49
3. Petroleum Resources and Production in Japan .... 80
4. Mining for Oil in Japan ..... 89
5. Japanese Petroleum Statistics ..... 97
6. Petroleum and Natural Gas Production in Japan, 1946 Fiscal Year ..... 107

OCCUPIED AREA REPORTS

1. Korean Mineral Industry Statistics ..... 23
2. The Honkeiko Colliery Disaster ..... 29
3. The Fushun Coal Field, Manchuria ..... 68
4. Sources of Coal in East Asia (prelim. study) ..... 19
5. The Mineral Industry of Korea in 1944 ..... 35
6. The Mineral Resources of Southern Korea ..... 84
7. Formosa Metal and Mineral Statistics (prelim. study) ..... 1
8. Sources of Bauxite in Asia (prelim. study) ..... 26
9. Sources of Phosphate for Japan, and Supplement .. 12

HYDROLOGY REPORTS

1. Hydrology of Japan ..... 43
2. Hydroelectric Power in Japan ..... 39

*Exploration.* Failure to employ modern geological methods in the search for ore, as well as the lack of good geologic maps, has hampered the mineral exploration program. In addition, geologic training in Japanese universities is not well adapted to the practical requirements of the mineral industries. Basic field experience is lacking among many geologists, who are inclined to pursue academic research without regard for the pressing need to find new ore to support Japan's recovering economy.

Division geologists and engineers are actively working to improve the geological techniques employed by Japanese geologists, and it is hoped that discoveries of new ore reserves made as the result of these studies will prove that geological study, if properly employed, will pay for itself. Some progress is being made in this direction, and, in at least two companies, the geological or prospecting departments have been enlarged to a point where they employ three times as many technologists as the other technical departments. Wider use of modern geophysical prospecting methods is being advocated, and encouragement is being given to the application of newer techniques in exploration, such as geochemical prospecting, and the study of alteration zones in the wall rock around ore bodies. To assist in bringing new ideas to the operators, a Japanese mining geologist was sent to the United States for a three-month tour in 1949 to study American methods. He has since been of great help in presenting improved operating techniques.

The Japanese Geological Survey is being assisted in the development of programs designed to aid the mining industry in the search for new ore reserves, and cooperation between government agencies and private organizations, so badly needed for a sound exploration program, is being fostered. The organization of a technical service organization, the Metals and Industrial Minerals Exploration Advancement Committee, is expected to bring about more efficient and more successful mineral exploration. This group, formed at the suggestion of Alan M. Bateman, of Yale University, while he was on duty with the Mining and Geology Division as a visiting expert consultant, is composed of representatives of the Geological Survey, the Japanese Mining Bureau, universities, and mining companies and is to serve as a coordinating agency and an advisory group on various mineral exploration programs.

*Mining operation and techniques.* Japanese mining methods are, in many instances, inefficient. Equipment is worn or obsolete, and ore bodies are in poor condition for current and future mining operations because of overproduction during the war years and lack of subsequent development. Costs have increased. Under the fiscal policy which scales down subsidies, operators must produce without the guaranteed profits they enjoyed under the old cost-plus system, almost the only condition under which many mining executives in Japan have operated, and the one that has been in existence since 1938. Through counsel and guidance, improvements in methods and techniques have been made, but much remains to be done if indigenous production is to be increased sufficiently to satisfy the needs of industry.

To eliminate the wasteful trial-and-error methods of mining employed in the past because of insufficient knowledge regarding the size, shape, and character of ore bodies, more prospecting and development work on mineral deposits prior to mining have been advised. More detailed geological mapping in mines and adjacent mineralized areas is being urged, in addition to the wider use of diamond drills. An effective new tool for the geologist and development engineer is a high-speed diamond drill designed from specifications provided by division engineers.

Ore extraction methods, a source of high costs and production inefficiency, have been receiving careful study. Efficiency can be raised and costs lowered by added attention to the fundamentals of good mining practice, even though existing Japanese equipment is employed. Wherever it becomes apparent that reduction in costs, conservation of ore reserves, or higher-grade mill heads can be achieved, changes in mining methods are being recommended, also.

Where ore is being diluted by breaking excessive quantities of waste, operators are being assisted to devise methods by which ore and waste may be broken separately. This problem, common in Japanese mines, has added substantially to the cost of hauling and hoisting. Simply by drilling shorter holes and using self-rotating machines in narrow stopes, much can be done to eliminate excess waste in the ore. In certain large, massive deposits long-hole drilling equipment is proving its worth. Wet drilling and water sprays are being introduced, wherever possible, to reduce dust. In development work, improved footage is being obtained by better drilling patterns. Work is also being done on the use of detachable bits.

Although additional benefits in increased production and lowered costs can probably be obtained by mechanization of some operations, determination of appropriate mechanization plans is awaiting time studies, which should have been a continuing concern of management, but which are almost completely lacking. As a first step, however, it has been found possible for many Japanese mines to install scrapers and mucking or loading machines.

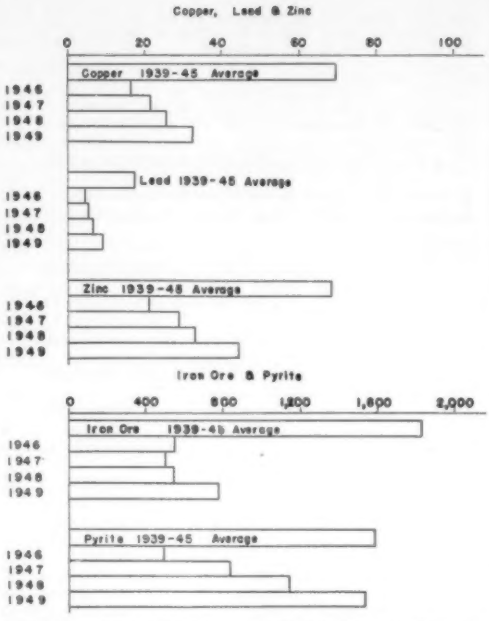



FIG. 1. Mine production of copper, lead, zinc, iron ore, and pyrite in Japan (copper, lead, zinc, metal content of concentrates; iron ore, pyrite, concentrates [iron ore 50% Fe; pyrite 42% S, approximately]). Source: Japanese Mining Bureau.

Costs can also be reduced by proper installation and utilization of existing equipment. Fundamentally poor installation, such as air lines with acute bends and other restrictions, have been found, and corrective action has been advised. Improvement in layout of underground haulage systems has been stressed. Better track maintenance is needed to prevent frequent derailings and other transportation difficulties, which increase the cost per ton of ore hauled.

*Milling.* Without more efficient milling or beneficiation, the advantages gained by improvements in mining practice will be offset by losses in waste and low-grade concentrates. One source of high mineral loss in Japanese ore-dressing plants was the poor quality of flotation chemicals. Because of competition provided by American chemicals imported at the suggestion of division milling specialists, Japanese manufacturers have improved the quality of their product, and there have been marked improvements in mineral recovery.

Increased accuracy in sampling methods, and the use of automatic controls and reagent feeders, have been

urged to bring about greater efficiency. The results are proving to the mill operators the wisdom of adopting modern methods. Closer liaison between commercial mineral dressing laboratories and operators in the field is also being advised, because current Japanese practice tends to experiment on a production level, where small mistakes mean large monetary losses. As an example, a new 400-ton per day flotation plant was shut down for revision of the mill layout immediately after completion, because of poor recovery. Through laboratory investigation, also, it is hoped that improved methods of ore dressing can be developed as needed to solve certain complex ore extraction problems involving an epithermal copper-lead-zinc ore.

By using newer techniques, such as heavy media methods in the primary separation of ore and waste, operating costs have been reduced, and improved recoveries have been made possible without major changes in mill designs.

*Production.* Efficiency has been increased since the beginning of the Occupation, but output has been increased as well. Pyrite output, particularly, has shown remarkable gains, rising from about 600,000 metric tons in 1946 to 1,535,000 metric tons in 1949, a gain of 250 percent. Output of major minerals as compared with output during the years of maximum production is shown in Fig. 1.

## Coal Mining Industry

*Historical development.* The existence of coal in Japan has been known for centuries, as evidenced by numerous references to black "burning rocks" in historical literature. Commercial development and use of coal, however, were not initiated until late in the Tokugawa period. The oldest records indicate that the coal in the Joban coal fields, about 120 miles north of Tokyo, has been known at least since 1819. Some mining was done in the southern extension of the field in 1853, and many large-scale operations were started at the beginning of the Meiji Era (1863). At about the same time coal mining was begun in Kyushu. American geologists and engineers were instrumental in bringing about expansion of mining activities in Kyushu, as well as in developing Hokkaido during 1873–75. During the late nineteenth century and the first quarter of the twentieth, coal mining expanded in Japan under the influence of increasing industrialization.

During the 1930–45 period of expansion, attention was turned to the mainland of Asia and to Sakhalin in the search for higher-quality industrial coal. New mines were opened during this period, but progressive exploration lagged seriously. Interest in coal utilization was pronounced, however, and detailed studies of the properties of Japanese coal were made by research organizations.

Wasteful mining practices prevailed during World War II, without proper regard for future development or conditions of the mines. Geological studies were almost completely neglected. The result of overexploitation and lack of development was apparent at the beginning of the Occupation, when coal production dropped to less than 600,000 tons a month, in contrast with prewar production of more than 3 million tons monthly.

*Exploration.* At the beginning of the Occupation, it was found that the last coal survey in Japan had been completed in 1932. Nothing was being done to locate new reserves, particularly of higher grade, and ignorance of geological conditions was increasing development and mining costs. The problems involved in planning a coal exploration program are many, because of the intense folding and faulting of the coal-bearing formations. Thorough and careful planning is of paramount importance. Therefore, in October, 1947, a committee designated as the Coal Exploration Advisory Committee, or CEAC, was organized with the assistance of Mining and Geology Division personnel, for the purpose of coordinating the efforts of various agencies concerned with coal exploration. In May, 1949, the Committee—by then an officially recognized advisory committee of the Japanese government—was renamed the Coal Field Exploration Council, or CFEC.

Division technical personnel have made available the latest information on developments in geological and geophysical methods, and have assisted in planning exploration programs sponsored by the CFEC and conducted by representatives of the Japanese Geological Survey, the Coal Production Bureau, universities, and mining companies. Raymond C. Moore, of the University of Kansas, served with the division as an expert consultant during the summer of 1949, working closely with the CFEC in the planning of the coal surveys.

So far, the CFEC has completed a compilation of data on all geophysical surveys in coal fields and a summary discussion of the areas mapped; a compilation of research projects on coking properties of Japanese coals; preparation of a standard classification for Japanese coal deposits; establishment of standard coal reserve computing methods; and a 5-year program for the recalculation and tabulation of national coal reserves and for the survey of metallurgical coking coal reserves. With the assistance and coordination of the committee, geological mapping, geophysical surveys, and diamond- or core-drilling projects are being undertaken by agencies of the Japanese government on a cooperative basis with coal mining companies. Additional reserves already delineated as the result of the intensified exploration

program are estimated to total more than 2 billion tons, a substantial increase when it is remembered that total proved reserves were estimated to be only slightly over 16 billion tons in 1932.

*Rehabilitation of the coal mining industry.* Coal production, which had been decreasing during the last year of hostilities, dropped to a low of 500,000 metric tons a month in November, 1945, as the Occupation began, compared with an output of nearly 4 million tons a month during 1940–43. One of the first programs inaugurated under the guidance of the Supreme Commander for the Allied Powers was that of maximizing production of coal to revitalize industry and to prevent disease and unrest. A vigorous program of mine rehabilitation was found to be required.

In addition to geological studies of coal-producing or potential coal-producing areas, the division is responsible also for furnishing technical and engineering advice on the coal mining industry to other staff sections of the headquarters, as well as to the Japanese mine operators. This responsibility required studies of all producing areas and of the mining industry. Japanese mine operators were provided with information on new coal-mining equipment, its uses and limitations, and on new or different methods of mining coal. The need for selective mining was stressed so that the high-quality coal required for industrial use could be made available. Ways have been devised for mining the thin coal seams that are so common in Japan. The industry has made a phenomenal recovery, with production in 1949 averaging over 3 million tons monthly, or 65 percent of the nation's wartime output. At least a part of this recovery has been due to the efforts of SCAP and Japanese expediting teams, which were dispatched to the coal-producing areas during the winter of 1947–48 to provide assistance on spot problems.

Because most of the coal in Japan is of low or medium quality, and because only minor amounts of coking coal and anthracite are available, industrial demands for high-quality and special-purpose coals have required investigations designed to upgrade the coal produced. The Mining and Geology Division is assisting in this program by providing consultation on techniques and on the construction of facilities needed for improving quality by washing or other methods, such as flotation or heavy media separation. H. F. Yancey, of the U. S. Bureau of Mines, has assisted in this phase of the work. Similarly, studies are in progress to improve the quality of Japanese anthracite for use in fertilizer manufacture, thus reducing import requirements.

*Coking coal.* Japan has relied in the past on the importation of special coking coals from other countries, chiefly North China, Manchuria, Sakhalin, and French Indo-China. These were blended with native coals to obtain a metallurgical coke having an adequate stability index for blast furnace use. The coals of Japan are all medium- to low-grade high-volatile bituminous, and even the limited supply of so-called coking coal will not, by itself, produce good metallurgical coke. The loss of North China and Manchuria as sources of low-volatile coking coal made the recovery of the steel industry to the desired level an almost impossible task. A program for the importation of coking coal from the United States and Canada was planned, to bring into Japan more than a million tons of such coal during the 1948–49 fiscal year. The cost of, roughly, $26,000,000 was high, but it was necessary to bring about industrial recovery.

The problem of making Japan self-sufficient in metallurgical coke has been studied by technicians of the Mining and Geology Division with the aid of consultants. The results have been published, notably in Natural Resources Section Preliminary Study No. 2, *Coke in Japan* (November, 1946), and Natural Resources Section Report No. 74, *Low Temperature Carbonization of Coal in Japan* (April, 1947). It was found that research laboratories of the leading steel companies, gas manufacturers, and the Fuels Research Institute had made exhaustive studies of the coking characteristics of Japanese coals prior to World War II, investigated all methods of mixing Japanese coals, and attempted to improve coking technology in order to produce metallurgical coke of proper quality from native coals. Some success was claimed, but the results as a whole were disappointing. Perhaps the most important of the experiments carried on by the Japanese, and the one that gave a starting point for further investigation, was in connection with low-temperature carbonization and the development of the product known as "coalite."

In December, 1948, when indigenous coal production was beginning to come up to industrial requirements and thought could be given to selective allocation of special-purpose coal, the division investigated the possibility of eliminating imported coal for making metallurgical coke. Frank H. Reed, of the Illinois State Geological Survey, was assigned to the Division as a visiting expert consultant. As a result of Dr. Reed's investigations, it was concluded that Japan could become largely self-sufficient in coking coal in about two to three years. Dr. Reed recommended that an American with broad experience in the manufacture and utilization of metallurgical coke be assigned to General Headquarters, SCAP, to provide guidance on an intensified research program by the Japanese to assist them in achieving self-sufficiency. Accordingly, Caleb Davies, Jr., of the Disco

Corporation, Pittsburgh, was recruited, with the assistance of A. C. Fieldner, of the U. S. Bureau of Mines, and assigned to this project.

Under Mr. Davies' direction, small-scale research has progressed to full-scale industrial trials. A large blast furnace is now being operated satisfactorily, using coke made exclusively from a mixture of Japanese coal and coalite, which is produced by low-temperature carbonization of noncoking Japanese coal. Research is continuing on other methods for improving coke quality. Imports of American coking coal have been suspended, and it is believed that vigorous action on some of the expedients already suggested may put the Japanese blast-furnace coke industry in a position to get along with much less imported coal. Further work may eliminate imported coal entirely.

## Metallurgy

*Historical development.* The practice of metallurgy in Japan dates back over 1,000 years, but it was not until the late nineteenth century that Japan began to adopt methods used in other parts of the world. Equipment designs were imported and processing units built and operated, and from 1920 to 1933, Japanese metallurgical plants went through a new epoch of modernization. Even so, they were unable to keep abreast of the rest of the world in operating technique and equipment; consequently, in many respects, they are as much as 20 years behind recent American practice. In addition, many plants had overexpanded without regard to efficiency, to meet the military demands beginning in 1933.

At the end of hostilities, about 15 percent of the metallurgical industry had been rendered inoperative, and all plants were in poor physical condition because of a lack of proper maintenance during the previous two years. About 80 percent of the undamaged plant facilities were closed down, and the remaining 20 percent were operating at greatly reduced capacity. Efficient operation at only a fraction of rated capacity was virtually impossible.

With assistance and encouragement from SCAP technologists, rehabilitation of metallurgical plants was undertaken by operators. Basic investigations were conducted by division technologists to provide a guide for operations; 11 survey reports on metals and metallurgy were prepared and published. By 1949, production of iron and steel had reached 20–40 percent of production capacity; aluminum, 20–30 percent; copper, 60–70 percent; lead, 30–40 percent; and zinc, 40–50 percent. It should be noted that copper production is high because about one-half of it represents industrial salvage brass scrap.

Continuation of technical advice and guidance is imperative for the complete rehabilitation and recovery of the metallurgical industry. It is hoped that the Japanese will soon begin to solve their own problems and to accept responsibility for developing and instituting new ideas and methods in plant practice. Thus far the tradition of government support through subsidy has been a strong deterrent to management initiative.

*Iron and steel metallurgy.* Japan always has been critically short of domestic high-grade iron ores and coking coals suitable for modern blast-furnace use. There are reserves of low-grade, complex iron ores that could reduce the need for high-cost imports. General ferrous metallurgical practice employed by the Japanese is modern, but their techniques, patterned after those of pre-World War II America and Germany, are not completely up to date.

To become self-sufficient in iron and steel, Japan must turn to improved means of processing and utilizing domestic resources. Research attention has been directed, therefore, toward utilization of methods, other than the modern blast furnace, for reducing iron minerals to metallic iron; processing of domestic coals to produce a desirable coke for the modern blast furnace; reduction of waste and improvement of product through the application of metallurgical controls; and education of workers and management in safe operating practices.

The most promising of the methods for reducing the minerals contained in low-grade iron ores to metallic iron are the rotary kiln, the small blast furnace, and the electric furnace. Such operations are small and are not expected to replace the modern blast furnace, but they should aid in reducing imports of high-grade coke or coking coal and iron ore for the production of pig iron. The operation of open-hearth furnaces is also being studied, because further reductions in overall operating costs are known to be possible in the open-hearth plants. It has been suggested that basic open-hearth slags be processed with phosphate rock to produce a fused phosphate fertilizer. Such an operation would ease the demand on the sulfuric acid industry, but the complex nature of the processing will require research before commercial-scale production can be expected.

General understanding and acceptance of the concept of metallurgical control have been realized during the past year. Several major steel companies have organized special metallurgical control groups.

Although progress has been made in improving the quality of coke from low-quality domestic coals, the beneficiation of low-grade domestic iron and manganese ores is yet to be investigated. These are basic problems for the Japanese iron and steel industry, the practical solution of which can make the industry virtually independent of imports.

*Copper metallurgy.* The difficulties facing Japanese copper producers are many, ranging from those introduced by low-grade or complex raw materials used as furnace feed to inefficient refinery operation. Almost 50 percent of Japan's refined copper has been obtained through the recovery of copper in scrap in the past two years. The practice of treating brass scrap in the converter and blast furnace is popular with plant operators, because it lowers the cost per ton of copper produced. Unfortunately, almost all the zinc contained in the brass is lost either in the blast-furnace slag or to the atmosphere as zinc oxide fume. About 600 tons of zinc a month are being lost through this practice. Only one metallurgical plant in Japan is equipped to recover the zinc. Additional waste is occurring because most copper-bearing ores or concentrates treated are not only low in copper content, but commonly the zinc content nearly equals that of copper, and it, too, is lost to the atmosphere or to the slag dump.

Some progress is being made on the solution of these problems. Japanese operators are investigating the recovery of zinc, the production of higher-grade copper concentrates, and the improvement of zinc and pyrite recovery from copper-zinc-pyrite ores. The standard method of copper smelting in Japan has been a so-called semipyritic method. The sulfur dioxide gas from the pyrite in the charge is diluted to such an extent that its value for use in the manufacture of sulfuric acid is lost. Through the use of larger proportions of coke or coal in the charge, pyrite that now provides fuel for smelting could be employed in the manufacture of sulfuric acid.

Blister copper anodes are produced without previously fire-refining the blister copper in a reverberatory furnace, as is done in the United States. The more highly refined anodes produced by reverberatory treatment make possible increased current efficiency and improved operations of the refinery, and the processing of anode slimes is simplified. Also, the grade of the electrolytic copper produced is higher and more uniform. Japanese practice has made use of rotary convertors for producing blister copper. Although the quality of the anodes thus produced is not high, minor modifications in the design and operation of the rotary convertors should improve the quality of the product, and eliminate the need for constructing reverberatory furnaces, thus saving money for the plant operators.

It has been found that the Japanese copper refineries have many areas for improved operating efficiency, especially in the more careful use of controls and control instruments. Improvement in starting sheet-stripping operations and in poling has been introduced. However, until the plant operators are convinced that improved efficiency can be obtained and costs reduced, progress will continue to be slow.

*Other metals.* At the beginning of the Occupation, Japanese lead smelting, both by blast and by electric furnaces, was inefficient compared to American practice. With little attention being given to the preparation of the furnace charge to insure proper chemical composition, furnace operation was wasteful and metallurgically unsatisfactory, and power cost was high. No advantage has been taken of fire-refining in production of bullion suited for those needs not requiring lead of high purity.

As with other metallurgical plants, the basic need found in the zinc metallurgical industry was that of increasing operating efficiency, with an attendant reduction in operating costs and an increase in the recovery of the metals and by-products. Reconditioning of equipment would aid materially, and the use of automatic control instruments would raise efficiency. Careful attention to upgrading the zinc content of concentrates fed to the plants is needed, and elimination of metallurgically undesirable materials from the concentrates would lessen the interference with metallurgical recovery. By-product recovery should be increased and, finally, methods should be devised to recover thousands of tons of zinc from zinc residues that have been stockpiled for many years. These stockpiles, assaying from 12 to 25 percent zinc, 2 to 5 percent lead, 0.5 to 4 percent copper, with a gram of gold, and 200 to 500 grams of silver per ton, constitute a valuable resource that Japan cannot afford to waste.

Some progress is being made in the treatment of residue stockpiles. One plant is operating its Waelz process plant for recovering zinc from zinc leaching plant residues. A second has completed pilot plant studies with idle equipment, developing a somewhat novel zinc fuming process, and indications are that the idle equipment can be utilized, with only a small investment necessary for units that cannot be salvaged from equipment on hand. A third plant has been conducting pilot plant studies on the processing of zinc residues, utilizing equipment installed during the war, but little progress has been made because of weakness of the technical staff.

Japanese nonferrous metallurgical plants are losing about 8,000 tons of sulfur per month as sulfur dioxide gas. If a recovery of 75 percent could be realized, it would reduce the demands on the pyrite producers by about 6,000 tons of sulfur, or 18,000 tons of 100 percent acid per month. Mining and Geology Division personnel have worked constantly with the Japanese to stop this waste. Four companies have taken initial steps to install sulfuric acid plants at their smelters for a combined monthly production of

about 12,000 tons of 100 percent acid. Even after these plants are in operation and producing to capacity, sulfur dioxide equivalent to about 12,000 tons of 100 percent sulfuric acid will still be lost to the atmosphere. That the industry continue its efforts to reduce this loss is considered to be of utmost importance by division personnel.

Large losses in the metallurgical industry have been traced to transportation and storage. With a competent technical organization much of this inefficiency could be eliminated. In many instances, flotation concentrates were stockpiled on the ground in the open, where the elements could carry away much of the material. The unsystematic transportation of solutions and solids within the area of the metallurgical plant is also a source of excessive loss. Management has been encouraged to correct these conditions, but much remains to be done.

### Petroleum Producing Industry

Although insignificant in contrast to the petroleum production of the United States, Japan's petroleum requirements have been met in large measure by imports. To insure an effective contribution to the national economy by indigenous petroleum production, the basic need of the industry at the beginning of the Occupation was the discovery of new reserves for future exploitation. Lack of exploration in the home islands during the period of hostilities left the industry in a state where practically all the known reserves were fully drilled. From a high of 28 million barrels following the discovery of the rich Yabase oil field in 1934, the proved reserves dropped steadily to about 16 million barrels in 1945.

*Exploration.* Although the standard of normal geological exploration was reasonably high, subsurface studies of producing fields and the application of micropaleontological methods had just been introduced at the beginning of the Occupation, chiefly as a result of Japanese experience during the occupation of the East Indies oil fields. Under the guidance of division petroleum geologists, the intensive study of the subsurface structure of the oil fields has resulted in new reserves being found in the present producing fields. Micropaleontological research has been of considerable importance in development of stratigraphic trap fields in Niigata Prefecture. On the recommendation of the division, a Japanese micropaleontologist was sent to the United States to study the operations of modern commercial micropaleontological laboratories and to obtain information that can be used in the recently established micropaleontological laboratory in Japan.

Geophysical methods of exploration for oil were barely in the experimental stage at the beginning of the Occupation. Seismic reflection equipment in use was outmoded and in poor condition, and gravity surveys were conducted by a cumbersome torsion balance method. New portable gravity meters have speeded up the rate of gravity survey many times, and the importation of modern seismic reflection equipment has yielded more rapid and precise results than were formerly obtainable.

The notable results already achieved in exploration are primarily due to coordination of the exploration potential and development of sound exploration programs based on a scientific foundation by the Petroleum Resources Development Promotion Council (formerly Petroleum Exploration Advancement Committee), which was established by the Ministry of Commerce and Industry[3] in January, 1947, at the suggestion of the division, as the first of such technical committees.

It is expected that the council will be helpful in the future in advising on measures for exploitation of oil reservoirs to insure maximum efficient recovery. It will also be able to assist in the development of an equitable system of royalty payment on production from subsidized exploration projects, to enable the government to recover funds expended on such subsidies.

As a result of the intensive exploration program conducted under the general direction of the PRDPC and with the assistance of division petroleum geologists, the proved reserves were maintained at the 1945 level of about 16 million barrels until 1948. During 1949 significant discoveries caused the first major uptrend since 1935, and the proved reserves at the end of 1949 were more than 21 million barrels. Discoveries include the new Narahashi and Nishi-Ishinazaka oil fields in Yamagata Prefecture, and extensions of producing zones in Yabase and elsewhere. The exploration program since 1946 can be credited with a contribution of more than 9 million barrels of new reserves. In addition to the proved reserves, a study of geologic probabilities and past production history indicates that the probable reserves may be as high as 70 million barrels, with the possibility of 50 million barrels more in the Toyama and Aomori districts of northwestern Honshu. Unknown potentialities also exist in large structures in Hokkaido, and in the large unexplored basin of the Kanto plain, north of Tokyo.

*Petroleum engineering.* Detailed field investigations of Japanese drilling and petroleum production operations showed that there was considerable room for improvement, for standards were about equivalent to the level reached elsewhere in the world more than a decade ago.

[3] Now called Ministry of International Trade and Industry. The old name will be used in this paper to avoid confusion.

Failure to maintain proper physical characteristics of drilling mud in rotary wells caused considerable delays in drilling schedules and reduced the number of wells that could be drilled annually. Poor cementing techniques resulted in many failures to cement off water-bearing horizons behind the casing. Modern techniques for oil-well cementing were introduced, and skid-mounted cementing units were imported to increase the efficiency of these operations.

One of the major difficulties in drilling for oil in Japan is transportation of heavy equipment to the drilling location. Access roads are generally lacking in both rice paddy and hilly terrain. Introduction of wooden plank tracks which do not require a full foundation road, because of spreading of the load over the length of the planks, has cut the cost of access by nearly one-half in the Yabase field. These plank tracks can be lifted in sections and used again for other locations.

The major development in petroleum engineering in Japan is the mastering of directional drilling. In 1949 new drilling techniques enabled the major producing company to drill 167,831 feet, an increase of 32 percent over that of the next best year during the Occupation. Because all drilling rigs in Japan are operated by electric power, the Mining and Geology Division recommended the importation of Diesel engines to supply power for drilling in remote locations where electric power can only be brought in at great expense, and also to overcome the stoppages that occur in the winter because of power failures in the northern prefectures. To test the possibilities of production from the Cretaceous of Hokkaido, a deep-drilling rig, capable of penetrating at least 10,000 feet, was imported, arriving in Japan during December, 1949. Methods of completing oil wells have been improved by the use of oil-base drilling muds, selective gun perforation of productive horizons, gravel packing in loose oil sands, and other techniques. More efficient production from completed wells has been effected by more rigid control of flowing wells, isolation of individual producing zones by the use of production packers, and more efficient pumping.

As a result of these programs the first uptrend in production since 1935 occurred in 1949, with a production of 1,368,050 barrels, an increase of 22 percent over that of 1948 (Fig. 2). To obtain practical instruction and observe modern techniques of drilling, completion, and production operations, two Japanese petroleum engineers were sent to the United States for ninety days, starting on their mission in November, 1949.

The technical departments of the major oil-producing company have been entirely dominated by drilling and production engineers, and the planning of exploration and exploitation programs, which should be executed by personnel with wide knowledge of the geological factors, has been subject to their approval and control. Division petroleum specialists have recommended reorganization and subdivision of the production department into exploration, exploitation, and mechanical operations departments. This system was widely adopted late in 1948, with the result that planning of exploration and exploitation drilling is now based on a firm scientific foundation, and drilling has kept abreast of the planned schedules for the first time since the beginning of the Occupation.

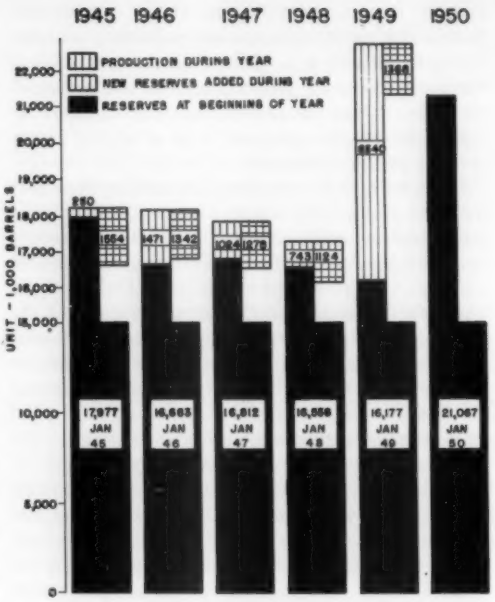



FIG. 2. Petroleum production and reserves, Japan.

## PUBLIC AGENCIES

Agencies of the Japanese government concerned with the mineral industry have had a tradition of control and administration of the industry rather than of service to the public. A concept of service through technical aid to the industry is being encouraged by Mining and Geology Division personnel, but the average government employee still thinks in terms of "control" rather than assistance. The aid of private companies is being enlisted in the effort to induce the government to carry its share of the burden, by encouraging requests from company personnel for government technical advice. The government mineral agencies and mineral technologists, however, are in low repute in mineral industry. Company representatives are extremely skeptical of the ability of the

government to do any constructive work for the industry at this time, and, until there is a major change in the philosophy of the government agencies, the opinion of industry that demands for assistance will result in little but expenditure of public funds will prevail.

*Coordination of exploration.* Certain concrete steps have been taken to prepare the government agencies to assume their just responsibilities in the mineral field. The principal of these is the organization of the exploration coordinating and advising committees, composed of representatives of such agencies as the Mining Bureau, Coal Production Bureau, Geological Survey, the universities, and mining companies. These committees, in keeping with the Japanese tradition, coordinate and advise on mineral exploration programs. The first of the committees, the Petroleum Resources Development Promotion Council (formerly the Petroleum Exploration Advancement Committee) was formed in January, 1947. A similar group in the field of coal exploration was organized in early 1948; and in mid-1949, after the success of the groups in coal and petroleum became apparent, and the mining industry had recovered to the point that new exploration and development could be undertaken, the Metals and Industrial Minerals Exploration Advancement Committee was formed. Through organizations such as these, geological information in the files of the government agencies, mining companies, and universities can be brought together, correlated, and made available to serve as a basis for further work. Individual representatives on the committees can be designated to undertake the collection or tabulation of information, or this responsibility can be delegated to one or another of the participating groups. It is hoped that ultimately, as a result of the work of these coordinating committees, the Japanese government agencies will recognize the need for added mineral research, technologic assistance to the mining industry, and coordinated exploration for mineral deposits.

*Geological Survey.* In part as a result of efforts by MIMEAC members, and in part through studies made by visiting expert consultants such as Alan M. Bateman, the Japanese Geological Survey has undergone some reorganization. To insure that it will provide more in the way of service to the country and to the mining industry and be less a refuge for scientists engaged in academic research, a new geological mapping program has been undertaken that will cover mineral districts where this type of work is needed most critically. Policy has been revised to permit more work related to the practical side of geology, with greater emphasis on economics or on projects of economic importance.

*Mining law.* Japanese mining law is in the process of being rewritten by the government, with the assistance of Mining and Geology Division consultants and consultants from the Legal Section of SCAP General Headquarters. Royal R. Duncan, formerly with the Solicitors Office, U. S. Department of the Interior, Washington, D. C., has provided indispensable guidance. The law is being simplified, and nonmetallic and other minerals not previously covered by the mining law will be included in the revised edition. To encourage the exploration and exploitation of mineralized areas, provisions are being drafted so that claims cannot be held without some attempt being made to develop a producing mine. By limiting the term of prospecting rights to 2 years, with not more than one 2-year extension, it is hoped to eliminate the practice, followed by many companies, of blanketing large areas of Japan with claims that can be held indefinitely without development. This system has assured perpetuation of ownership and has limited the development of mineral resources. With revision of this section of the mining law, the mining companies are expected to divest themselves of some of their holdings so that other individuals with sufficient capital can undertake mineral exploitation. The law will prescribe minimum government control and regulation of mineral beneficiation, milling, smelting, and refining. It should be noted that industry is not seriously concerned about government controls because, as one executive put it, "in return for assistance we must expect some controls."

*Mine safety.* With the increase of coal output, consideration has been given to the high accident rate which, when calculated on the basis of million metric tons of coal mined, is the highest of any country on record in the world. At the end of the Japanese fiscal year 1948, the rate was 27.7 fatalities per million metric tons. In comparison, the fatality rate in American bituminous coal mines was 1.3 fatalities per million tons mined in 1948. Statistical data prior to 1945 are meager and not wholly reliable, but are sufficient to indicate that the accident rate in Japan has always been higher than in other countries of the world.

Early in the Occupation, division engineers began to study ways to decrease the accident rate in Japanese coal mines. The first attack on the problem was through a study of existing safety laws and regulations, which had been in effect since 1916. Although the laws covered all phases of mining, they provided no minimum standards of safety and no penalty provisions that could be enforced. They were also complicated—many provisions could not be understood, much less observed. The responsibility of the government with respect to mine safety was not clearly drawn. More than one agency was charged with

responsibility for safety in some phase of the mining industry. The agencies compiled data received from regional and district officers but made few inspections. No real authority existed for the enforcement of regulations. Neither were the regulations specific enough to determine actual violations.

In March, 1948, the help of Russell B. Warncke, a mine safety specialist from the U. S. Bureau of Mines, was sought by the Mining and Geology Division to study safety practices in Japanese mines and to recommend changes in safety regulations. As a result of this work, a mine safety code was drafted, modeled after the U. S. code. Division personnel also completed drafts of metal mine and petroleum industry safety codes. The codes were delivered to the Japanese government as inclosures in a memorandum dated August 24, 1948, directing the Japanese to prepare safety codes, using the prepared drafts as guides. They were also instructed to assign responsibility for mine safety to a suitable government agency.

The Ministry of Commerce and Industry was designated as the responsible agency for supervision of mine safety, on December 23, 1948. A revised mine safety law was passed on May 17, 1949, by the Japanese Diet, and implementing ordinances for the enforcement of the safety law were issued on August 12, 1949. An important feature of the law provides for the organization of mine safety committees composed of worker and management representatives, following the practice in American coal mines. It is hoped that through the work of these committees both workers and management will evolve a proper understanding of responsibility for safe working practices, recognizing that only through sincere cooperative efforts can safe working conditions be obtained. To provide incentives for working safely, consideration is being given to the establishment of a safety association, similar to the Joseph A. Holmes Safety Association in America. Methods of financing awards of merit are now being investigated.

The programs leading to the rehabilitation of Japan's mining and petroleum industry have been developed largely along the lines of technical assistance and guidance. However, differences in economic and political background required that some attention be given to developing a new concept of governmental responsibility rather than control. Also, the long history of government support made it necessary to convince management of the feasibility of operating without subsidy.

Reasonable success has been achieved in improving technical operations. In such fields as petroleum geology, coal exploration, metal mining, mill recoveries, coal mining practices, the coking coal problem, metallurgical plant operation, and petroleum drilling operations, progress has been satisfactory. Advances in other areas have not been as encouraging. Government officials control and administer rather than "serve" industry. Management expends more effort toward keeping government subsidies than to improving operations. In spite of the slow progress, however, a start has been made, and the influence of such real achievements as the introduction of the new safety code will spread.

It is clear that the basic concept underlying all the programs—namely, that of bringing about changes and improvements by providing advice and suggestions rather than providing the complete answer—is a sound one. After years of being told, the Japanese technologist is beginning to think for himself again and to solve his own problems. As the technologist improves the process and lowers costs, management will come to appreciate once more that a subsidy is not the only answer to an operating problem.

# Wortley Fuller Rudd: 1876–1950

R. Blackwell Smith

*School of Pharmacy, Medical College of Virgina, Richmond*

WORTLEY FULLER RUDD, dean emeritus of the School of Pharmacy of the Medical College of Virginia, died at Richmond, Virginia, on July 26, 1950.

Dean Rudd was born at Skinquarter in Chesterfield County, Virginia, on October 6, 1876, the son of the late Alfred A. and Indie Cauthorne Rudd. There he received his early education, moving on later to the University of Richmond, which awarded him the A.B. degree in 1898.

Following a period of high-school teaching at Brookneal Institute, and in the public schools of Manchester and Richmond, Dean Rudd entered the Medical College of Virginia and received the Bachelor of Pharmacy degree in 1902. In 1911 he was awarded the degree of Master of Arts in chemistry by Columbia University.

From the day he entered the Medical College of Virginia, where as a student he was named quiz master in chemistry, Dean Rudd's life was dedicated to the college, its schools, and, above all, its students. Seldom does a man give himself to a cause to the extent to which Dean Rudd gave himself to education—and particularly, but not exclusively—to pharmaceutical education. For years he taught with little assistance all the chemistry given in the schools of medicine, dentistry, pharmacy, and nursing. His appointment as instructor in pharmacy came in 1906, as professor of chemistry in 1910. In 1920 he succeeded Albert Bolenbaugh as dean of the School of Pharmacy, which post he held until his retirement on July 1, 1947.

During his period of service, Dean Rudd's interests were wide and varied, and the recognition that came to him testifies to his effectiveness in the organizations to which he gave his efforts. He served as president of the American Association of Colleges of Pharmacy, the Southern Association of Science and Industry, the Virginia Academy of Science, and the Virginia Section of the American Chemical Society. He also served on the governing boards of the Richmond Professional Institute of the College of William and Mary and the Virginia State Chamber of Commerce. For many years he stood high in the councils of the American Pharmaceutical Association.

His work in creating, and his term as president of, the Southern Association of Science and Industry gave impetus in its beginning to an organization now grown strong in its task of bringing about closer coordination among Southern educators, scientists, and industrialists. His terms as head of the Virginia Section of the American Chemical Society brought new vigor, which the section has never lost. He was honored with its Distinguished Service Award in 1948. His presidency of the Virginia Academy of Science was prosecuted with such effectiveness that in 1941 he was named Virginia's Man of the Year in Science, and in 1950 an honorary member of the Academy. His service as president of the American Association of Colleges of Pharmacy advanced appreciably the continuing task of raising the standards of pharmaceutical education. Ample evidence is the citation that accompanied the honorary doctorate of science conferred upon him by the University of Maryland in 1941, which praised him for "doing as much, it not more, than any one person as teacher, writer, editor and association worker, to advance the standards of pharmaceutical education, to elevate the practice of pharmacy and to enlist the support of pharmacists for the advancement of science in general."

His contributions were also recognized by the University of Tampa, which conferred upon him an honorary doctorate of humane letters, and by the Medical College of Virginia, which conferred upon him his second honorary doctorate of science. One of his most cherished possessions was the Herty Medal, awarded him by the Georgia Section of the American Chemical Society for his outstanding contributions to chemistry in the Southeast.

This partial recitation of his achievements tells but little of the man who was loved and respected by several generations of students for his high character and personal traits. Few know the many students who are today successful practitioners of medicine, dentistry, and pharmacy because Dean Rudd held out a helping hand when financial or academic problems seemed too difficult to overcome. Many had the delightful experience of being guests in the home he made with his beloved wife, the former Kate P. Vaden, who survives him. Here they welcomed their friends, young and old, and it was an unusual evening that did not find them entertaining informally those who dropped in at 1614 Park Avenue. Those who knew the warmth of his friendship and hospitality will never forget him.

# Technical Papers

## Evidence for the Entry into the Upper Atmosphere of High-speed Protons during Auroral Activity

**A. B. Meinel**

*Yerkes Observatory,*
*University of Chicago, Williams Bay, Wisconsin*

During the intense auroral activity on the nights of August 18–19 and 19–20, 1950, several spectra were taken with the spectrograph designed by the writer (*1*). It will take some time to analyze all the information contained in these spectra, but one result of the observation seems worth recording at once.

A spectrum of an auroral arc in the magnetic zenith taken on August 19–20 showed that the H-alpha emission line is strongly asymmetric to the violet. On this occasion the spectrograph was pointed parallel to the magnetic lines of force so that any incident auroral particles would be approaching the spectrograph. The profile of H-alpha is found to be asymmetrical, with a maximum violet displacement of 60 A, corresponding to a velocity of 2,800 km/sec. The H-alpha line viewed perpendicularly to the magnetic lines is, however, symmetrical and undisplaced, but it is broadened by approximately 6 A. The red edge of the asymmetrical H-alpha emission has a profile showing a similar spread of 6 A. Broadened hydrogen lines have been observed before by Gartlein (*2*). These earlier observations, however, were made with the spectrograph pointed normal to the magnetic lines. Consequently, no Doppler displacements of the kind noted here have been observed before. These observations therefore establish for the first time that protons of probably solar origin are streaming into the upper atmosphere at velocities of the order of 2,500–3,000 km/sec.

### References

1. Meinel, A. B. *Publ. Astro. Soc. Pacific*, **60**, 257 (1948); also *Astrophys. J.*, **111**, 555 (1950).
2. Gartlein, C. W. *Trans. Am. Geophys. Union*, **31**, 19 (1950).

## Speed of Salt Increase in the Waters of Lake Tacarigua, Venezuela

**Augusto Bonazzi**

*Universidad Central de Venezuela, Caracas*

Lake Tacarigua (or Valencia), recently described by Crist and Chardon (*1*), and Jahn (*2*), lies in the valley of Aragua, the center of a zone of fluvial and lacustrine deposits that form the depression in the intrusive and metamorphic mass of the Cordillera de la Costa in northern Venezuela.

According to Aguerrevere and Zuloaga (*3*), the lake was formed after the development of the peneplane and during the process of general uplift of the mountain range. It occupied in 1939 an approximate area of 436 sq km (*4*).

Today the lake has no visible outlet and rests on water-worked deposits that have been found by Berry (*4*) to be more than 450 ft deep in the southeast quadrant, near Tocoron, which was on dry land at the time of his study. On the other hand, Lopez (*5*) did not find mother rock at a depth of 60 m near Naguanagua, a suburb north of the city of Valencia, whereas he found it at a depth of 160 m in the northern outskirts of the city proper. It is evident from this that the gravel beds forming the bottom of the depression extend beyond the area of the existing lake.

Of great interest in the present connection are the well-defined wave-worn escarpments found by Berry on the island of Horno, the oldest, chronologically, being 50 ft above the surface of the waters.

Within historic times Lake Tacarigua has suffered changes in level (*6*) that have been summarized by Crist and Chardon, and, according to Humboldt (*7*), Boussingault (*8*), and Codazzi (*9*), the valley of Aragua was a region of intensive and productive agriculture during the first part of the nineteenth century.

As part of a biologic study of the waters of the lake begun by Bonazzi in 1946, several analyses were made during that and the following years. The methods of the A.P.H.A. were followed, and the results are reported in Table 1.

According to Codazzi (*10*), analyses of these same waters made by Boussingault and Rivero (probably 1830–40) yielded a concentration of 1:2,000 of sodium, calcium, and magnesium carbonates and calcium sulphate.

TABLE 1

Analyses of the Waters of Lake Tacarigua

| | | Sample No. | | | |
|---|---|---|---|---|---|
| | | 1 | 2, 3, 4 | 5, 6 | 7 |
| Date of sampling (1947) | | August | August | October | October |
| Distance from shore, m | | 300 | 500 | 300 | 100 |
| Depth of sample, m | | 3 | 0.25–3.0 | 36 | 7.6 |
| pH | | 7.75 | 7.75 | 7.60 | 7.60 |
| Total solids, ppm | | 971.0 | 971.0 | 970.0 | 970.0 |
| Dissolved oxygen | | 6.21 | 5.18 | 0.00 | 6.89 |
| Carbonates | $CO_3$ | — | 37.60 | 35.40 | 35.40 |
| Bicarbonates | $HCO_3$ | — | 462.80 | 422.00 | 390.00 |
| Nitric nitrogen | N | 0.57 | 0.54 | 9.24 | 4.16 |
| Chlorides | Cl | 52.70 | 52.70 | 30.24 | 37.00 |
| Total iron | $Fe_2O_3$ | 0.58 | 0.53 | 0.21 | 0.34 |
| Calcium | CaO | 21.55 | 18.49 | 45.26 | 79.91 |
| Magnesium | MgO | 67.45 | 68.33 | 56.28 | 45.99 |
| Silica | $SiO_2$ | 23.00 | 24.00 | 17.60 | 15.00 |
| Alumina | $Al_2O_3$ | — | — | 3.80 | 3.20 |
| Sulphates | $SO_4$ | 353.00 | 353.46 | 332.91 | 329.83 |
| Sodium | $Na_2O$ | 105.00 | 104.16 | — | — |

In 1920 Delgado Palacios (*11*) found these same waters to contain 784.8 ppm of total salts, and Wieder (*12*) found a total salt concentration of 931–945 ppm a few years later (1939). From these data it is possible to construct the curve shown in Fig. 1.

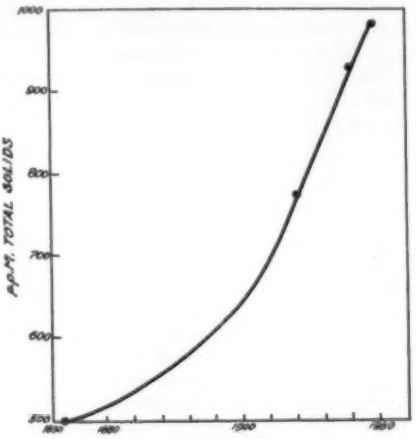



FIG. 1.

In an attempt to locate the origin of these large salt concentrations, Bonazzi in 1948 submitted the waters of a number of tributary streams to analysis. Sampling was left for the driest period of the year (March), since at that time the salt content of the waters logically should be at its highest. Many of the smaller tributaries were dry, so that sampling was done only of the rivers mentioned in Table 2, above the place where there could

TABLE 2

ANALYSES OF TRIBUTARY STREAMS, 1947 AND 1948

| | | Sampling localities | | | | |
|---|---|---|---|---|---|---|
| | | R. Guigue | Station 6 | R. Guayos | R. Delicias | R. Aragua |
| Silica | $SiO_2$ | 0.0 | 0.0 | 6.20 | 1.20 | 9.2 |
| Alumina | $Al_2O_3$ | 0.0 | 0.0 | 1.38 | — | 0.84 |
| Total iron | $Fe_2O_3$ | — | — | 4.82 | 5.28 | 8.36 |
| Calcium | CaO | 41.48 | 61.02 | 96.06 | 6.18 | 104.00 |
| Magnesium | MgO | 8.90 | 15.60 | 12.60 | 2.00 | 13.80 |
| Sulphates | $SO_4$ | 19.00 | 46.50 | 31.80 | 3.40 | 41.70 |
| Chlorides | Cl | 4.83 | 12.07 | 7.24 | 4.83 | 6.04 |
| Total solids, ppm | | 74.0 | 173.5 | 149.0 | 32.0 | 161.0 |

be a possibility of contamination from salts previously deposited in the lowlands or where the rivers might be passing through a salty area.

From the foregoing it is evident that the total salt concentration of the tributary streams today fluctuates around 118 ppm, the $SO_4$ around 28.5 ppm, and the Cl around 7.0 ppm.

The values presented in this paper may explain the mechanism of salinification of many agricultural soils of the valley of Aragua, which in some extreme cases have been found to contain 11,150 ppm of Cl and 28,604 ppm of $SO_4$. Evidently this process was already in progress in the early part of the 19th century and has recently become intensified.

### References


1. CRIST, R. E., and CHARDON, C. E. *Geogr. Rev.*, **1941**, 430 (1941).
2. JAHN, A. *Biol. Acad. Nacion. Hist.*, **23**, 448 (1940).
3. AGUERREVERE, P. E., and ZULOAGA, G. *Bol. Geol. Min. Caracas*, **1**, 25 (1937).
4. BERRY, E. W. *Proc. Am. Phil. Soc.*, **81**, 547 (1939).
5. LOPEZ, V. *Rev. Fomento*, **4**, 47 (1942).
6. BERRY, E. *Op. cit.*
7. HUMBOLDT, A. *Viajes en las regiones equinocciales.* Caracas: Biblioteca Venezolana de Cultura, 1940.
8. BOUSSINGAULT, J. B. In J. Acosta (Ed.), *Viajes cientificos a los Andes Ecuatoriales, Nueva Granada, Ecuador y Venezula.* Paris: 1849.
9. CODAZZI, A. *Resumen Geogr. Venezuela*, **3**, 53 (1841).
10. *Ibid.* 55 (1841).
11. DELGADO, P. F. In I. Chacin (Ed.), *Algunas consideraciones sobre las aguas de Caracas y otros lugares vecinos.* Caracas: Author, 1920.
12. WIEDER, H. In R. Fernandez Garcia (Ed.), *Inform. An. Estac. Experim. Agr. Zoot.* Caracas: Minist. Agr. y Cria, 1939. Vol. 67.


## The Synthesis of 1,1,1-Trichloro-2,2-bis-(4′-Chlorophenyl-4′-$C^{14}$)-ethane


**Melvin Fields, James Gibbs, and Doris E. Walz**

***Chemical Research Laboratory, Tracerlab, Inc. Boston, Massachusetts***


In order to make available for tracer studies samples of the potent insecticide DDT [1,1,1-trichloro-2,2-bis-(4′-chlorophenyl)-ethane], we undertook the synthesis of this compound labeled in the benzene rings with carbon 14. Since both benzene-1-$C^{14}$ (*1*) and aniline-1-$C^{14}$ (*2*) are readily accessible, we investigated the preparation of tagged chlorobenzene by direct chlorination of benzene, as well as by the Sandmeyer reaction with aniline.

When chlorine is allowed to react with an excess of benzene in the presence of suitable catalysts such as aluminum turnings or iron and iodine, chlorobenzene is obtained in 80–90% yield based on the benzene actually consumed, and the formation of more highly chlorinated derivatives occurs to only a limited extent (*3, 4*). In the presence of an iron-iodine catalyst in a sealed tube at temperatures from 0° to 30°, the reaction of equimolar quantities of benzene and chlorine afforded chlorobenzene in yields ranging from 42 to 65%, together with unreacted benzene and considerable quantities of dichlorobenzene and resin.

The preparation of chlorobenzene was most satisfactorily achieved by reaction of benzene diazonium chloride with hot cuprous chloride solution (*5*). This procedure afforded pure chlorobenzene in 68–75% over-all yield from aniline, and is of particular advantage in the small-scale preparation of the labeled halide, since it yields a uniquely labeled derivative, and avoids the necessity of

separating the product from more highly chlorinated material.

The reaction of chlorobenzene and chloral hydrate in the presence of various condensing agents has been the subject of numerous investigations. With concentrated sulfuric acid, the reaction of chloral with a 10% excess of chlorobenzene afforded *p,p'*-DDT, mp 106.5°–107.5° C, in about 45% yield (*6*); anhydrous hydrogen fluoride has also been employed, but the yield of pure *p,p'*-DDT by this technique was not reported (*7*). With chlorosulfonic acid, Cook and co-workers obtained *p,p'*-DDT, mp 104°–105° C, in approximately 62% yield (*8*); under similar conditions we obtained pure *p,p'*-DDT, mp 108.5°–109.5° C, in yields that ranged from 40–50% based on chlorobenzene. The substitution of chloral for its hydrate, or the use of 10% excess chlorobenzene, failed to improve the yield of pure material.

### Preparation of Chlorobenzene

A. *Chlorination with gaseous chlorine.* Generation of known quantities of chlorine was accomplished by the addition of excess concentrated hydrochloric acid solution to potassium permanganate as described by Graebe (*9*). The apparatus consisted of a generating flask equipped with a gas inlet tube and connected through a pressure-equalizing dropping funnel to a series of 4 gas washing bottles and then to 2 spiral traps attached to a small manifold. Potassium permanganate (254 mg) was placed in the generating flask; after the system had been flushed with a slow stream of nitrogen, the spiral traps were immersed in liquid nitrogen and 18 ml of concentrated hydrochloric acid solution was added slowly to the permanganate. When the vigorous reaction had subsided, the mixture was heated to boiling to complete the generation of chlorine, which was swept with a stream of nitrogen through 1 wash bottle filled with water and 2 containing concentrated sulfuric acid into the liquid nitrogen traps. After 45 min the spiral traps and manifold were isolated from the generating system and evacuated to $10^{-6}$ mm. By distillation of the product into an excess of alkali, and titration with standard thiosulfate solution, the yield of chlorine was estimated to be 90% of that calculated from the permanganate employed.

Under high vacuum 38.9 millimoles of dry chlorine was distilled into a 500-ml rb flask immersed in liquid nitrogen and containing 3.00 g (38.9 mM) of benzene, 30 mg of iodine, and 30 mg of iron wire. The reaction vessel was sealed and immersed in a bath at 0°–2.5° C; after 4 hr in the dark at this temperature, the flask was opened, its contents were dissolved in ether, and the solution was washed with alkali and water. Distillation afforded 2.79 g (65%) of chlorobenzene, bp 125°–135° C, $n_D^{26°}$, 1.5176–1.5242, as well as 1.06 g of higher boiling products.

B. *Sandmeyer reaction.* Aniline hydrochloride, 6.50 g (50 mM) was diazotized at −10° C with nitrous acid. Cuprous chloride, freshly prepared from 15.6 g copper sulfate, was dissolved in 22 ml of concentrated hydrochloric acid solution in a 500-ml 3-neck flask. The reaction vessel was equipped with a mercury-sealed Hershberg stirrer, a pressure-equalizing dropping funnel, and an efficient condenser, which was connected by means of ground glass joints to a trap immersed in liquid nitrogen. The solution of cold diazonium salt was transferred to the dropping funnel and added at a moderate rate to the hot solution of cuprous chloride. A rapid evolution of nitrogen began immediately; stirring was continued with no external heating for 15 min after the addition was complete. The reaction mixture was extracted with ether, and the flask and condenser were rinsed with ether to recover droplets of chlorobenzene carried into the condensing system by the rapid evolution of nitrogen. The ether extracts, washed with alkali and water, were dried over calcium chloride. Distillation afforded 4.12 g (73%) of chlorobenzene, bp 125°–129.5° C; $n_D^{26.5°}$, 1.5198.

### 1,1,1-Trichloro-2,2-bis-(4′-chlorophenyl)-ethane

A 100-ml 3-neck rb flask was equipped with a mercury-sealed Hershberg stirrer, a drying tube filled with potassium hydroxide, and a pressure-equalizing dropping funnel prepared from a 5-ml graduated pipette with a capillary tip; 2.98 g (19 mM) of finely ground chloral hydrate, mp 59°–60° C, was dissolved with stirring and warming in 4.05 g (36 mM) of chlorobenzene. When solution was complete, the flask was cooled to 10° C in an ice bath and 2.32 ml (36 mM) of freshly distilled chlorosulfonic acid was added at the rate of 1–2 drops/sec, with vigorous stirring. Addition was complete after about 90 min, during which time the reaction mixture became somewhat dark; the ice bath was removed, and hydrogen chloride was evolved as the mixture slowly came to room temperature. Stirring at room temperature was continued for 20 hr, during which time the product precipitated as a crystalline mass.

After addition of a few ml of ice water, the mixture was extracted with a total of 30–40 ml of carbon tetrachloride; the organic extract was washed with cold water, with 2% sodium carbonate solution, and again with cold water. Concentration of the dry solution in vacuum afforded a colorless oil, which was transferred to a 50-ml centrifuge tube with 15 ml of 95% ethanol. On cooling, crude DDT, mp 97°–102° C, was obtained in yields which varied from 75–85%; a second crystallization from 95% ethanol afforded pure *p,p'*-DDT, mp 108.5°–109.5° C, in over-all yields of 40–50%.

A sample of 1,1,1-trichloro-2,2-bis-(4′-chlorophenyl-4′-$C^{14}$)-ethane prepared from chlorobenzene-1-$C^{14}$ under the conditions described above had a specific activity of approximately 54 μc/mM.

### References


1. Fields, M., Leaffer, M. A., and Rohan, J. *Science*, **109**, 35 (1949).
2. Fields, M., Rothchild, S., and Leaffer, M. A. Unpublished results.
3. Gindraux, L. *Helv. Chim. Acta.*, **12**, 923 (1929).
4. Meunier, J. *Compt. rend.*, **170**, 1451 (1920).
5. Sandmeyer, T. *Ber.*, **17**, 1633 (1884).
6. Mosher, H. S., *et al. Ind. Eng. Chem.*, **38**, 916 (1946).
7. Simons, J. H., *et al. J. Am. Chem. Soc.*, **68**, 1613 (1946).
8. Cook, W. A., Cook, K. H., and Rueggeberg, W. H. C. *Ind. Eng. Chem.*, **39**, 868 (1947).
9. Graebe, W. *Ber.*, **35**, 43 (1902).

# Effect of Propylene and Triethylene Glycol on Atomized *E. coli*

**Rudolph Nagy and Gail Mouromseff**

***Research Laboratory, Westinghouse Electric Corporation, Bloomfield, New Jersey***

The use of propylene and triethylene glycol as an air disinfectant has received considerable publicity in recent years. Twort *et al.* (*15*) have made an extensive survey of the efficacy of various germicides dissolved in glycol solvents, in destroying airborne organisms. However, these authors did not report any bactericidal effect by glycols per se. Robertson *et al.* (*13*) reported that propylene glycol as an aerosol possessed marked germicidal properties. Robertson *et al.* (*12*) and Puck *et al.* (*8*) believed that propylene glycol vapor destroyed certain respiratory pathogens when 1 g of the vapor was present in 50,000,000 ml of air. Robertson *et al.* (*14*) also stated that the virus of influenza could be inactivated by glycol vapor in a 1:3,000,000 dilution.

In discussing the mechanism of glycol disinfection, Puck (*5*) attributed the killing action to the high concentration of glycol as a result of condensation of the vapors onto the droplets containing the organisms. He assumed that in about 20 sec the droplets condensed 20 times as much glycol as the weight of the original particle. As shown by Wells (*16*), the rate of fall of such a particle would be greatly accelerated, and it would appear that the removal of the organisms from the air by means of glycol could be accounted for by a mechanical process.

use of glycols have been summarized by the Committee on Sanitary Engineering, National Research Council, Division of Medical Science (*17*). The physical conditions under which the organisms are removed from the air appear to be very critical. It would seem that further study is required to elucidate the mechanism of glycol action and its effectiveness in air sterilization. The present paper reports the results of some experiments made to determine whether the removal of bacteria from the air, by vapors of triethylene glycol, is lethal or merely mechanical.

*Experimental chamber tests.* The experimental chamber was a box 4 ft on each side, as described by Rentschler and Nagy (*9*). A specially constructed drawer in the bottom of the box was so arranged that a number of sterile Petri plates could be exposed for various periods of time after spraying the organisms into various types of atmospheres with or without glycol. *Escherichia coli* was used as the test organism for all the experiments. Simultaneously with the plates, bacteria were collected with a Luckiesh-Holladay-Taylor (*3*) electrostatic precipitator.

A dilution of 0.1 ml of a 24-hr culture of *E. coli* was made in 20 ml of broth and this bacterial suspension was sprayed into the chamber using a Devilbiss spray gun at an air pressure of 50 psi so as to produce a fine spray. After 30-sec settling of the spray to remove the very large droplets, both the Petri plates and precipitator were used to collect the organisms. The Petri plates were exposed for only 2 min, so there would not be too many colonies per plate. The plates in the precipitator were changed every 5 min until 4 sets were collected. All

TABLE 1

COMPARISON OF THE PLATE COUNTS OF *E. coli* SPRAYED INTO VARIOUS ATMOSPHERES OF A TEST CHAMBER

| Test No. | Type of atmosphere | Relative humidity, % | No. of *E. coli* settling on plates in 2 min | Plate count from precipitator | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | 1st 5 min | 2nd 5 min | 3rd 5 min | 4th 5 min | Total |
| 1 | *E. coli* in air | 50 | 2,800 | 10,000 | 1,890 | 2,450 | 1,450 | 15,890 |
| 2 | Propylene glycol aerosol 1 g–1,700,000 ml of air followed by *E. coli* | 65 | 3,400 | 11,300 | 1,750 | 1,300 | 835 | 15,225 |
| 3 | Propylene glycol 1 g–1,700,000 ml of air sprayed simultaneously with *E. coli* | 75 | 4,000 | 12,000 | 1,950 | 1,460 | 1,070 | 16,730 |
| 4 | Air saturated with propylene glycol vapor followed by *E. coli* | 73 | 3,400 | 9,700 | 5,400 | 2,020 | 330 | 17,450 |
| 5 | Water vapor followed by *E. coli* | 95 | 2,800 | 10,000 | 1,460 | 430 | 205 | 12,095 |

Hamburger *et al.* (*1*) and Puck *et al.* (*7*) showed that glycol vapors were not effective against dustborne organisms. Puck (*5*) stated that the killing action is always a direct function of concentration of glycol vapor in air. The maximum effect is reported by Robertson (*11*) to be at about 60% relative humidity with the vapor at the saturation point. Under these conditions small variations in temperature will result in a fog and condensation on the walls. As the concentration of glycol is diminished below saturation, the apparent bactericidal action is diminished. Other difficulties in the practical

the plates were incubated for 24 hr at 37° C and the colonies were counted. The results of these tests are given in Table 1.

These results indicate that the organisms are removed from the air more rapidly with glycol than when no glycol is present. However, the total number of organisms settling on the plates is of the same order of magnitude as the controls without glycol, showing that the bacteria are not destroyed by glycol. The findings are consistent in that settling on Petri plates gave figures similar to those obtained with the precipitator. In those tests with

TABLE 2

TOTAL NUMBER OF *E. coli* COLLECTED ON PETRI PLATES IN A SCHOOLROOM WITH AND WITHOUT TRIETHYLENE GLYCOL VAPORS

| Without glycol (control) | | | With glycol | | | Relative humidity, % | Temperature in °F |
|---|---|---|---|---|---|---|---|
| Test | On plates | With precipitator | Test | On plates | With precipitator | | |
| A 1* | 8,171 | 2,800 | A 3 | 11,540 | 10,000 | 47 | 70° |
| 2 | 9,900 | 4,000 | 4 | 12,600 | 10,000 | | |
| 5 | 8,490 | 10,000 | | | | | |
| B 1 | 4,865 | 2,700 | B 3 | 9,530 | 5,000 | 46 | 70° |
| 2 | 6,570 | | 4 | 12,090 | | | |
| 5 | 9,640 | 6,000 | | | | | |
| C 1† | 6,080 | 6,000 | C 5† | 6,645 | 5,600 | 50 | 75° |
| 2 | 5,120 | 3,500 | 6 | 6,250 | 5,600 | | |
| 3 | 1,065 | 1,750 | 7 | 3,120 | 2,200 | | |
| 4 | 315 | 290 | 8 | 1,950 | | | |

* Sampling of the bacteria was in the order numbered.
† Sprayer turned off and samples collected every 15 min.

glycol the amount used was more than enough to saturate the atmosphere of the box. The effect of glycol on the bacteria apparently is the same as that of saturated air; namely, the droplets do not evaporate but settle rapidly, as seen in Test 5.

*School tests.* A local schoolroom was available to us for various epidemiological studies. During the absence of children, a commercial triethylene glycol vaporizer was installed in the room and tested for its efficacy in destroying *E. coli*. The vaporizer was adjustable so that different amounts of triethylene glycol vapor could be introduced into the air. The infector was an Arnold vaporizer emitting a constant fine spray of *E. coli*, suspended in dilute broth. The bacterial sprayer was in operation throughout an entire series of tests. Sterile Petri plates located at various points in the schoolroom were used as collectors. In addition, samples were also collected by means of a Luckiesh-Holladay-Taylor precipitator. Sampling of the air for each test was done for 20 min. When glycol was used, the vaporizer was on for an hour before the bacterial sprayer was turned on. This was to insure that the amount of glycol in the air was near saturation. The results of a series of tests are shown in Table 2.

The number of organisms collected by the Petri plates and the precipitator was greater when glycol was present than on the controls without glycol. This again shows that glycol vapors increase the rate of settling of droplets but that the organisms are not destroyed. This is especially evident in Test C, Table 2. In both cases (i.e., with and without glycol), the room was infected to approximately the same degree, but the number of organisms collected when glycol was present was relatively much greater.

*Duct and room tests.* A room 20 ft square and 11 ft high was equipped with a blower delivering approximately 600 cu ft of air/min, and with a duct so as to distribute the air evenly. The type of circulating system is very similar to that found in an office or home. An Arnold vaporizer at the entrance to the duct was used to contaminate the air with *E. coli*. A triethylene glycol vaporizer was placed about 8 ft inside the duct. All the bacteria entering the duct had to pass through the glycol vapors before emerging into the room. In the second part of the experiment the glycol vaporizer was placed in the center of the room. The air was sampled for 20 min by means of Petri plates located in various positions. Results of these experiments are shown in Table 3.

TABLE 3

TOTAL NUMBER OF *E. coli* COLLECTED ON PETRI PLATES IN ROOM WITH AND WITHOUT TRIETHYLENE GLYCOL

| Test No. | Control | Glycol | Relative humidity, % | Temp. in °F | Position of vaporizer |
|---|---|---|---|---|---|
| 1 | 5,830 | 5,940 | 50 | 70 | In duct |
| | 5,510 | 5,600 | | | In " |
| 2 | 279 | 311 | 35 | 70 | In " |
| 3 | 691 | 712 | 40 | 75 | In room |
| 4 | 292 | 370 | 45 | 70 | In " |
| 5 | 6,350 | 6,700 | 40 | 70 | In " |
| | 6,450 | 7,050 | | | |

The total number of bacteria settling on the Petri plates, whether or not triethylene glycol is present in the air, is within the limits of experimental error. Having the triethylene glycol vaporizer in the duct would appear to be the ideal position, according to Puck and Chaney (*6*), if the vapor were germicidal. All the organisms were intimately mixed with the vapors under these conditions. The vapors were not condensed on the side of the duct because the duct was very short; glycol was definitely detectable in the room. When the same amount of glycol that was sufficient to saturate the air was evaporated directly in the room, the results once more indicated that the vapors were not germicidal. The plate count with glycol in the air was again slightly higher, showing the mechanical removal of the organisms by glycol.

The results presented here show that glycols do not destroy bacteria. This is contrary to the results reported by Robertson and his collaborators. It would appear that there are some fundamental differences in technique or interpretation of data to account for such a discrepancy in results. Our present methods of spraying and

sampling *E. coli* have been effective in the collecting of organisms in air ducts, rooms, and test boxes over a period of 11 years (Rentschler *et al.* [*9*]). Settling of organisms on Petri plates has been shown to give reproducible results. This has also been demonstrated by Robertson *et al.* (*10*). To obviate the effect of air currents, as many as 10 Petri plates, placed in various positions in a room, were used for one test. In the experiments described, Petri plates, the Hollaender Dallavalle sampler, and the Luckiesh-Holladay-Taylor electrostatic precipitator placed at the bottom of the test box gave similar results. This indicates that sampling could not account for the variance in the figures of Robertson *et al.* and those in our work.

The amount of glycol in the air could not have been a factor in our tests. Both propylene and triethylene glycol were calculated to give a saturated atmosphere, and in the case of a commercial vaporizer the vapors were visible in the room. According to Puck (*5*), the killing is always a direct function of the concentration of glycol in the air. It would be expected, therefore, that some indication of bactericidal effect would be seen even when conditions were not optimum. However, the tests indicate that the glycols increased the rate of fall of the organisms and showed no germicidal action. Twort used propylene glycol with hexylresorcinol but did not observe any bactericidal effect of the glycol per se. Mallmann and Churchill (*4*) found that spores of bacteria and of *Aspergillus niger* and *Penicillium italicum* were unaffected by glycol vapors or sprays. They concluded that these compounds were not effective in controlling microbial contamination of cold storage and food preparation rooms.

The apparent germicidal, viruscidal effect of glycol can be attributed to the precipitating of water droplets from air containing bacteria or viruses.

Puck (*5*) calculated that the weight of a droplet increases 20 times by adsorption of glycol vapors. According to Stokes' law,

$$v = \frac{2gr^2(d_1 - d_2)}{9n},$$

where $v$ = velocity of fall in cm/sec, $g$ = gravity 980, $r$ = radius of particles, $n$ = coefficient of viscosity, $d_1$ = density of sphere, and $d_2$ = density of medium. The velocity of fall will be proportional to the square of the radius. If we take Robertson's (*12*) value of 3 μ as the diameter of a droplet, and the height of his experimental chamber as 15 in., it would take approximately 20 min for the organisms to settle. However, if the droplet increases in weight by 20 times and the diameter by three times, the rate of fall will be increased as the square of the radius so that the droplets will settle in 2.5 min. This is the value reported by Robertson (*11*) for the apparent germicidal and viruscidal action of glycols in his chamber. The Hollaender-Dallavalle (*2*) sampler in his apparatus would not have collected any more organisms after 2.5 min, whereas settling on Petri plates would have shown that all the organisms were precipitated, as in our tests. Using a larger box and the same size droplet, the length of time of settling would be proportional to the height, which accounts for the much longer settling time in our tests. The vapors do not condense on dust-borne organisms, and therefore the particles will remain suspended in air. It is conceivable that under practical conditions the glycol-precipitated organisms may lose their moisture and act as a reservoir for the reinfection of the air.

### References


1. Hamburger, M., Puck, T. T., and Robertson, O. H. *J. Infectious Diseases*, **76**, 208 (1945).
2. Hollaender, A., and Dallavalle, J. M. *Pub. Hlth. Rep.*, **54**, 574 (1939).
3. Luckiesh, M., Holladay, L. L., and Taylor, A. H. *Gen. Elec. Rev.*, **49**, 8 (1946).
4. Mallmann, W. L., and Churchill, E. S. *Refrig. Eng.*, June (1946).
5. Puck, T. T. *J. Exp. Med.*, **85**, 729 (1947).
6. Puck, T. T., and Chaney, A. L. *Ind. Hyg. Assoc. Quar.*, **7**(3) 10 (1946).
7. Puck, T. T., *et al. J. Infectious Diseases*, **76**, 216 (1945).
8. Puck, T. T., Robertson, O. H., and Lemon, H. M. *J. Exp. Med.*, **78**, 387 (1943).
9. Rentschler, H. C., and Nagy, R. *J. Bact.*, **44**, 85 (1941).
10. Robertson, O. H., Puck, T. T., and Wise, H. *J. Exp. Med.*, **84**, 559 (1946).
11. Robertson, O. H. *Wis. Med. J.*, **46**, 311 (1947).
12. Robertson, O. H., *et al. J. Exp. Med.*, **75**, 593 (1942).
13. Robertson, O. H., *et al. Science* **93**, 213 (1941).
14. Robertson, O. H., *et al. Science* **94**, 612 (1941).
15. Twort, C. C., *et al. J. Hyg.*, **40**, 253 (1940).
16. Wells, W. F. *Am. J. Hyg.*, **20**, 611 (1934).
17. Committee Sanitary Engineering, National Research Council, Div. of Medical Sciences. *Am. J. Pub. Health*, **37**, 189 (1947).


## Spade-Foot Toad Sperm as an Activating Agent in Producing Gynogenetic Haploid Embryos from *Rana* and *Pseudacris* Eggs


**Han-po Ting and John W. Price**

***Department of Zoology and Entomology***
***The Ohio State University, Columbus***


Much interest has been directed toward the study of the mode of development of haploid frog embryos by experimental embryologists and geneticists in their search for a better understanding of nucleocytoplasmic relationships. Gynogenetic haploid embryos, resulting from eggs activated by the penetration of spermatozoa and developing with egg-chromatin alone, have been produced by one of two methods: (*a*) eggs inseminated by sperm which had been moderately irradiated beforehand (*1, 2, 3*) or had been treated with certain chemicals (*4, 5*); or (*b*) by the use of foreign sperm as found by G. Hertwig (*6*) and Tchou (*7*) in their hybridization experiments with certain European species of anurans.

Realizing the convenience of this latter method, the writers have applied it in crossing a number of species of anurans occurring in the United States. We found that, when eggs of *Rana pipiens* and *Pseudacris nigrita triseriata* were inseminated with sperm of the spade-foot toad, *Scaphiopus holbrookii holbrookii*, the embryos ob-

tained were almost all haploid, as shown by their chromosome number studied cytologically. Only on two occasions among many crosses were a few gynogenetic diploid individuals found. The percentage of developing eggs in such crosses was always high, usually greater than that of the control group inseminated with sperm of its own species. Serial sections of the inseminated eggs show that the sperm head lies along the first cleavage spindle, but does not fuse with the female pronucleus. It is eliminated after the first division. A study of the chromosomes of the spade-foot toad shows that they are smaller in size than either those of *R. pipiens* or *P. nigrita triseriata*, and their diploid number is 26. The chromosome number of *R. pipiens* is 26, whereas that of *P. nigrita triseriata* is 24.

The above method is very convenient and requires little time to prepare the material when a large number of gynogenetic haploid embryos of *R. pipiens* or *P. nigrita triseriata* is needed for study. The toad can be kept alive in the laboratory in a container filled with damp loose soil for 2–3 months without feeding. A pair of adult testes is enough to inseminate several hundred eggs.

**References**


1. HERTWIG, G. *Arch. mikroskop. Anat.*, **81**, Abt. II, 87 (1913).
2. HERTWIG, O. *Ibid.* **77**, Abt. II, 1 (1911).
3. *Ibid.* **82**, Abt. II, 1 (1913).
4. HERTWIG, G. *Anat. Anz.*, **58**, Erg. Heft, 223 (1924).
5. DALCQ, A. *Arch. Biol.*, **43**, 343 (1932).
6. HERTWIG, G. *Arch. mikroskop. Anat.*, **91**, Abt. II, 203 (1918).
7. TCHOU-SU. *Arch. d'anat. micr.*, **27**, 1 (1931).


## Studies on Algal Epiphytes


**John W. King**

***Department of Biology,***
***Morgan State College, Baltimore, Maryland***


Studies have been undertaken to determine if certain algal epiphytes possess parasitic characteristics. Light on this problem can only be obtained through a careful study of the physiology of the host and the epiphyte, as well as a careful study of the histology of their attachment areas.

Obligate epiphytes and mild or partial parasites among the algae have been observed and discussed by many writers and investigators (*1–8*), but the literature does not contain thorough reports concerning their physiology and morphology. Many investigators postulated that some of these algae were parasitic simply because they showed preference for certain hosts. Knight (*3, 4*), in describing *Pylaiella* on *Fucus vesiculosus*, stated that the epiphyte shows exclusive preference for fucoids. This, she pointed out, suggests selective epiphytism or a parasitic relationship not of the obligate type. Chapman (*1*) pointed out that, since *Ectocarpus siliculosus* often penetrates the host tissue, the relationship is possibly an example of mild parasitism. Kylin (*5, 6*), as well as Fritsch (*2*), also mentioned similar conditions among the algae. In all cases, however, the writers and investigators have shown some doubt about the physiological and histological relationship between the epiphyte and the plant upon which it lives.

TABLE 1

SUMMARY OF ALGAE STUDIED

| Symbiotic relationships | Degree of penetration |
|---|---|
| *Polysophonia lanosa* on *Ascophyllum nodosum* | +++ |
| *Elachistea fucicola* on *A. nodosum* | + |
| *E. fucicola* on *Fucus vesiculosus* | + |
| *Spermothamnion turneri* on *Chondrus crispus* | ++ |
| *S. turneri* on *F. vesiculosus* | – |
| *Calothrix* sp. on *Fucus* sp. | – |
| *Calothrix* sp. on *Cystoclonium* sp. | + |
| *Acrochaetium moniliforme* on *Dasya pedicellata* | + |
| *Ceramium rubrum* on *Chondrus crispus* | – |
| *Ectocarpus siliculosus* on *Laminaria agardhii* | – |
| *E. siliculosus* on *Zostera marina* | ++ |
| *Polysiphonia varicgata* on *Chorda filum* | + |
| *Lithothamnion turneri* on *F. vesiculosus* | – |
| *Bangia ciliaris* on *Gelidium crinale* | – |
| *Erythrotricia* sp. on *Cladophora* sp. | – |
| *Acrochaetium* sp. on *Grinnellia* sp. | +++ |

+++ Cells of epiphyte penetrate deeply into tissue of host.
++ Cells of epiphyte penetrate just below the superficial cells of host.
– Cells of epiphyte do not penetrate tissue of host. host.
– Cells of epiphyte do not penetrate tissue of host.

During the summer of 1949 a number of algae epiphytes were collected in the vicinity of Woods Hole, Massachusetts, specifically on Penikese Island, Nobska Point, Martha's Vineyard, No Mans Land, and the Elizabeth Islands. Many microslides of the attachment areas of these epiphytes were made, and some of the slides were prepared by freehand sectioning, thereby making it possible to observe the living cells. Most of the slides, however, were prepared by the paraffin method, which made possible a more careful histological study.

Of the algae studied thus far, the attachment areas fall into four categories: those in which the cells of the epiphyte deeply penetrate the host; those in which they penetrate just below the superficial cells of the host; those in which they are wedged between the superficial cells of the host but go no further; and those in which they do not enter the host. At the present stage of this investigation, it is not the intention of the writer to imply conclusively that the degree of penetration of the epiphyte correlates with the degree of parasitism. Before such a conclusion can be drawn, studies must be made to determine whether the attachment areas observed represent a stage in the growth of the epiphyte or its ultimate growth.

Sufficient data have been obtained, however, to suggest that many of these so-called algal epiphytes may be symbionts of a nutritive antagonistic type, or of a nutritive reciprocal type. It can be observed from Table 1 that some of the algae deeply penetrated the tissues of the plant upon which they were growing. One that is of particular interest is *Polysiphonia lanosa* on *Ascophyllum*

*nodosum*. The hyphalike cells of *P. lanosa* penetrated well into the medulla of *A. nodosum*, thereby disturbing the latter's general histological pattern and producing a necrotic appearance. In living sections the red cells of *P. lanosa* produced a good natural contrast with the greenish-brown cells of *A. nodosum*. As *P. lanosa* pushed its way in, many cells of the host appeared to have become crushed or dissolved. Although cells of *P. lanosa* did not appear to be intracellular in relationship to the host, it is believed that there could be an exchange of elaborated foods similar to that reported in *Cuscuta* sp. (*9*). Further reports will be made on this problem as soon as more data are obtained.

### References


1. CHAPMAN, V. J. *J. Linnaean Soc. London, Botany*, 1937, **51**, 205.
2. FRITSCH, F. E. *The structure and reproduction of the algae*. New York: Macmillan, 1948. Vol. II.
3. KNIGHT, M. *Trans. Roy. Soc. Edinburgh*, 1923, **53**, (2), 343.
4. *Ibid.*, 1929, **56**, (2), 307.
5. KYLIN, H. *Botan. Notiser*, 1927, 275.
6. ———. *Botan. Rev.*, 1935, **1**, (4), 138.
7. PAPENFUSS, G. F. *Science*, 1933, **77**, 39.
8. ———. *Botan. Notiser*, 1934, 437.
9. THODAY, M. G. *Ann. Botany*, 1911, 655.


## The Control of Storage Sprouting in Onions by Preharvest Foliage Sprays of Maleic Hydrazide[1]


S. H. Wittwer and R. C. Sharma

*Department of Horticulture,*
*Michigan State College, East Lansing*


Chemicals such as the methyl ester of α-naphthaleneacetic acid (*1*) and 2,4,5-trichlorophenoxyacetic acid (*2*), which have markedly retarded the growth of sprouts in stored potatoes and, under some conditions, in vegetable root crops, have had no apparent inhibiting effect upon sprouting of onions. A possible explanation may be that the growing points in the onion are so firmly enclosed and protected by layers of leaf bases that the chemicals fail to penetrate to the meristems. It is well known from numerous herbicide tests that substituted phenoxy acids, in general, have little effect on monocotyledonous plants. In studies concerned with means of prolonging the storage life of onions, various growth substances were applied as preharvest foliage sprays. It was hoped that the intact growing plant might translocate the chemical or stimulus to the meristematic regions, making possible a penetration of the growth substance thus far not realized by postharvest treatments. There would be a possible added advantage in that the food product is treated only indirectly. Standard field spray equipment could also be utilized, thus eliminating many of the present difficulties incurred with treating produce after harvest.


[1] Journal Article No. 1157 of the Michigan Agricultural Experiment Station.


TABLE 1

EFFECT OF PREHARVEST FOLIAGE SPRAYS OF GROWTH REGULATORS ON SUBSEQUENT SPROUTING AND BREAKDOWN OF YELLOW SWEET SPANISH ONIONS IN STORAGE

| Treatments | Concentration (ppm) | Weight of sprouts (g/40 bulbs) | Percentage of storage loss from | |
|---|---|---|---|---|
| | | | Sprouting | Breakdown |
| Sodium salt of α-naphthalene acetic acid | 1,000 | 64.7 | 23 | 33 |
| | 5,000 | 36.8 | 22 | 40 |
| 2,4,5-trichlorophenoxyacetic acid | 10 | 67.4 | 23 | 35 |
| | 50 | 68.1 | 28 | 46 |
| Sodium salt of β-naphthoxyacetic acid | 500 | 22.2 | 19 | 48 |
| | 2,500 | 45.3 | 14 | 49 |
| Benzo-thiazol-2-oxyacetic acid | 500 | 40.4 | 20 | 48 |
| | 2,500 | 53.6 | 30 | 44 |
| Maleic hydrazide* | 100 | 31.7 | 26 | 40 |
| | 500 | 3.9 | 10 | 21 |
| | 2,500 | 0.0 | 0 | 15 |
| "Barsprout"—controls | | 28.8 | 26 | 60 |
| No treatment—controls | | 40.5 | 19 | 26 |
| Differences necessary for significance between treatments | 5% Level | 24.4 | 13 | 23 |
| | 1% " | 34.3 | 18 | 33 |

* Formulated as the water soluble diethanolamine salt of 1,2 dihydro 3,6 pyridazinedione, and supplied by the U. S. Rubber Company, Naugatuck Division, Naugatuck, Conn. Concentrations are expressed as ppm of active ingredient.

Yellow sweet Spanish onions were started from greenhouse-grown plants, seeded March 1, and transplanted into a field of productive mineral soil the second week in May. On August 15, when the tops were still green and approximately one-third of them were down, water solutions of various growth substances (Table 1) were sprayed on the foliage of four 20-ft row replicates. Triton B-1956 at a concentration of 0.1% was used as a wetting agent. The chemical solutions were applied at the rate of 75 gal per acre by means of 3-gal hand sprayers. One week following treatment the remainder of the tops were turned down. The onions were harvested August 29. After the bulbs were cured for 2 weeks at a temperature of 85° F and a relative humidity of 50 ± 7%, they were placed in replicated lots of 20 bulbs in kraft paper bags and removed to a cold storage room (35° F) for 30 days, following which they were held at a temperature of 55° ± 3° F and a relative humidity ranging from 65 to 85%. Two control comparisons were used (Table 1): nontreated lots, and a postharvest application in commercial dust form of the methyl ester of α-naphthaleneacetic acid equivalent to 0.9 g active ingredient per bu.[2]

Observations were made March 2 after the onions had been held in storage for 5 months. No sprouting was evident on bulbs that had been harvested from plants the tops of which had been sprayed with 2,500 ppm of maleic hydrazide (1,2 dihydro 3,6 pyridazinedione), and there was a significant reduction in sprouting with 500 ppm. Some decrease in loss from storage breakdown

[2] Formulated as "Barsprout" by the American Cyanamid Company, New York City.


FIG. 1. The effects of preharvest foliage sprays of maleic hydrazide on sprouting of sweet Spanish onions. A, controls (nontreated); B, maleic hydrazide, 500 ppm; C, maleic hydrazide, 2,500 ppm.

(Table 1) was also observed. Gross longitudinal sections of bulbs resulting from treatment with 2,500 ppm of maleic hydrazide revealed an internal structure that was normal and indistinguishable from nonsprouting controls (not treated). Flavor, color, and odor were apparently not affected. Some of the bulbs from plants that had received the 500 and 2,500 ppm of maleic hydrazide were held for an additional 6 weeks in storage at 55° F and photographed April 15 (Fig. 1). Similar lots of bulbs resulting from treatment with 2,500 ppm of maleic hydrazide and planted March 5 in the greenhouse remained sound but completely dormant for 8 weeks, whereas nontreated bulbs grew normally, producing profuse roots and large vegetative tops. Other chemicals caused no inhibition of sprouting. The sodium salt of α-naphthaleneacetic acid and 2,4,5-trichlorophenoxyacetic acid resulted in a significantly greater weight of sprouts, and the "Barsprout" formulation increased significantly the percentage of storage loss from breakdown (Table 1).

Some of the inhibiting effects of maleic hydrazide on plant growth have recently been described by Schoene and Hoffman (*3*), and subsequent reports (*4, 5, 6, 7, 8*) suggest that it has unique properties as a regulator of plant development. Results similar to those described herein for onions have been obtained with carrots, and studies are being conducted with other commonly stored root crops, sugar beets, and potatoes.

### References

1. DENNY, F. E. *Contrib. Boyce Thompson Inst.*, **12**, 387 (1942).
2. ELLISON, J. H., and SMITH, O. *Proc. Am. Soc. Hort. Sci.*, **54**, 447 (1949).
3. SCHOENE, D. L., and HOFFMAN, O. L. *Science*, **109**, 588 (1949).
4. FILLMORE, R. H. *Arnoldia*, **10**, 33 (1950).
5. MOORE, R. H. *Science*, **112**, 52 (1950).
6. NAYLOR, A. W., and DAVIS, E. A. *Proc. Am. Soc. Plant Physiol.* (24th meeting) Abst., 13 (1949).
7. NAYLOR, A. W. *Proc. Nat. Acad. Sci. U. S.*, **36**, 230 (1950).
8. WHITE, D. G. *Science*, **111**, 303 (1950).

## Loss of Choline Esterase Activity in Nerve Tissue Resulting from Processes of Histological Preparation[1]

**W. L. Hard and Merle D. Fox**

***Department of Anatomy, School of Medicine, University of South Dakota, Vermillion***

In the course of research involving studies of choline esterase activity in dog tissues, it became of interest to determine quantitatively how much of the enzyme activity present in fresh tissues remains in the paraffin-embedded tissues as employed in the histochemical technique (*1*).

For this purpose the entire cord and medulla of an adult dog were divided linearly into 48 approximately equal segments, weighed to the nearest 0.1 mg. Successive segments were then treated as follows: (*a*) the first segment was used to demonstrate the total enzyme activity present; (*b*) the second, maintained at refrigerated temperatures, was fixed in 95% alcohol for 6 hr, dehydrated in absolute alcohol for 12 hr, placed in a mixture of 1 part absolute alcohol and 1 part benzene for 30 min; (*c*) the third segment was treated as in (*b*) but in addition was immersed in melted paraffin at 52° C for 2 hr and deparaffinized in xylene for 1 hr; (*d*) the fourth segment was embedded, sectioned, and prepared by histochemical methods (*1*).

[1] Sponsored by a contract from the Office of Naval Research, Medical Sciences Division.

TABLE 1

| Hydrolysis in fresh tissue | To paraffin | | Through paraffin | |
|---|---|---|---|---|
| | Hydrolysis | % lost | Hydrolysis | % lost |
| 0.915 (1.68–0.37) | 0.54 (0.97–0.24) | 38.8 | 0.22 (0.38–0.08) | 76.0 |

The tissue blocks subjected to the various steps of fixation and embedding were then homogenized and extracted with 30% glycerine. The residual enzyme was determined by the microtitrametric method of Glick (*2*), using acetylcholine as the substrate in a concentration of 0.51%. Total hydrolysis was determined on 3 separate aliquots of extract from each tissue segment, yielding 39 determinations for each group of treated segments, *a*, *b*, and *c*. These data have been summarized (Table 1) by averaging all determinations, but the ranges are indicated by the bracketed figures. The highest values were obtained for the medulla and thence, in descending order, the lumbosacral enlargement, cervical, and thoracic cord. The standard error for all determintions proved to be 0.042. It may be noted here that extracts of nerve tissue and hemolyzed red cells hydrolyzed both myristoyl choline, as used in the histochemical technique (*1*), and acetylcholine in an essentially similar graphical configuration at varying but equivalent substrate concentrations. Thus, peak activities for both substrates were obtained at similar concentrations, and a parallel reduction in activity because of higher concentrations occurred for the 2 substrates. However, the total hydrolysis of myristoyl choline was only 54.2% that obtained for acetylcholine. We have felt justified in using the latter substrate to take advantage of this heightened total hydrolysis and reduce the potential error accordingly. The units of enzyme activity are expressed in μl of 0.1*N* NaOH/mg of tissue. For purposes of comparison, the enzyme concentration determined for the fresh, untreated segments was taken as 100% activity, and the loss expressed as the per cent activity remaining.

The process of fixation and dehydration destroys or inactivates about 38% of the enzyme present (Table 1), and paraffin embedding reduces enzyme activity an additional 38%. Thus three-fourths of the normal tissue enzyme activity is destroyed as a result of the rigors of fixation, dehydration, and embedding. This figure is not unlike previous reports of the loss of non-specific esterases (*3*) and phosphatases (*4*), wherein 60–95% loss in the respective enzymes was encountered in paraffin-embedded tissues. It would thus seem that consistently high enzyme losses for the esterases are to be expected in the preparation of paraffin-embedded tissues. Since the process of embedding is primarily concerned with the chemically inert substance paraffin, it is assumed that the major loss is due to the relatively high temperatures encountered. It may be recalled (*5*) that choline esterase is quite thermolabile, being rapidly inactivated at temperatures approaching 60° C.

Noting the high loss of enzyme activity in paraffin-embedded tissues, we found it possible to ascertain roughly the lower limits of enzyme concentration that must remain in the tissue in order to secure a positive histochemical reaction. In a series of experiments to be reported elsewhere, the cervical sympathetic cord was transected and the choline esterase activity in the superior ganglion determined by both histochemical and quantitative methods. Within 3 days postoperatively the histochemical reactions were negative, presumably because of loss of the enzyme in the degenerated terminal endings of the preganglionic neurons. However, quantitative determinations on these ganglia showed only a 10–15% loss of enzyme. To explain the negative histochemical results, it is presumed that the initial loss of enzyme (10%), together with the technical loss in preparing the sections (70%), results in some 20% of residual activity remaining as compared with the normal tissue, an amount insufficient to accommodate the necessary hydrolysis of the substrate to permit histochemical localization. There are undoubtedly other factors that further serve to limit the sensitivity of this reaction, but certainly the above evidence suggests that a negative histochemical reaction does not necessarily mean an absence of the enzyme, and, correspondingly, due caution should be exercised in interpreting this type of preparation. The value of making simultaneous quantitative studies, wherever the nature of the tissue elements permits, is self-evident.

**References**


1. Gomori, G. *Proc. Soc. Exp. Biol. Med.*, **68**, 354 (1948).
2. Glick, D. *Techniques of Histo- and Cytochemistry.* New York: Interscience, 1949.
3. Nachlas, M. M., and Seligman, A. M. *J. Nat. Cancer Inst.*, **9**, 415 (1949).
4. Stafford, R. O., and Atkinson, W. B. *Science*, **107**, 279 (1948).
5. Allens, G. A., and Hawes, R. C. *J. Biol. Chem.*, **133**, 375 (1940).


## A Technique for Whole Mount Autoradiographs of Rabbit Mammary Glands[1,2]


**Walter S. Lundahl, Joseph Meites, and L. F. Wolterink**

***Department of Physiology and Pharmacology, Michigan State College, East Lansing***


We have observed that growing mammary glands of rabbits and rats readily take up radioactive phosphorus ($P^{32}$). By the use of the autoradiographic technique described here, the extent of mammary proliferation, as well as the regions of most active growth, can be clearly differentiated.

Autoradiographs of the mammary glands of male and female rabbits were prepared by the following procedure:


[1] Published with the approval of the Director, Michigan Agricultural Experiment Station, as Journal Article No. 1159.

[2] This study was aided in part by a grant from the U. S. Atomic Energy Commission and by a grant-in-aid from the American Cancer Society upon recommendation of the Committee on Growth of the National Research Council.

A single intravenous injection of 50 μc of $P^{32}$ per kg of body weight was given, and the rabbits were sacrificed 4 hr later. A midline incision was made into the skin over the ventral surface, care being taken not to injure the mammary tissue underneath. The whole mammary glands were carefully dissected out with a sharp razor blade, washed in cold running water to remove adhering hair or blood, and stretched out flat on plywood or cork board with the aid of thumbtacks. The whole mount was then permitted to dry thoroughly under a heat lamp for 8–24 hr. Removal of tissue exudates was facilitated by frequent blotting. Such whole mammary gland mounts were found to require no further treatment and were sufficiently thin so that sectioning was unnecessary.

Autoradiographs were prepared approximately 24 hr after sacrificing the rabbits. A sheet of pliofilm was placed between the dried mammary tissue and the emulsion side of Eastman x-ray no-screen film. Good contact was obtained by inserting a square portion of heavy blotting paper over the tissue and holding the entire preparation in place between plywood by clamps or weights. Exposure time was 72 hr.

Counts were made of some of the mammary tissue 24 hr after sacrificing the animals. One-half-inch circular discs, weighing approximately 132 mg, were cut from areas close to the nipples of the glands and counted under a thin mica end-window counter. These averaged 15 cps, or about 0.01 μcuries per disc.

Fig. 1 shows an autoradiograph of a growing mammary gland taken from a male rabbit. This gland had been developed by injecting 0.1 μg of estrone and 1.0 mg of progesterone daily for 35 days. The radioactive phosphorus was injected on the 35th day, and the animal was sacrificed 4 hr later. It can be seen that most of the $P^{32}$ is localized in the peripheral area and in the nipple, or in the regions of maximal growth in the gland. The lobule-alveolar system is well developed.

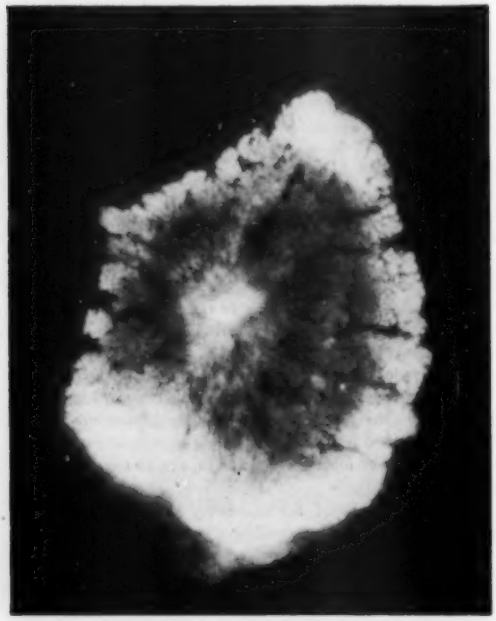


FIG. 1. Autoradiograph showing distribution of $P^{32}$ in a growing mammary gland from a male rabbit.

FIG. 2. Autoradiograph showing distribution of $P^{32}$ in a nongrowing, atrophic mammary gland from a male rabbit.

Fig. 2 is a radioautograph taken from a nonproliferating, atrophic mammary gland of a male rabbit. Mammary growth had been induced by injecting estrone and progesterone for 25 days. Hormone administration was then stopped for the following 10 days, and on the 35th day $P^{32}$ was injected. It can be seen that, with the exception of an area near the center of the gland, the $P^{32}$ is distributed uniformly. Unlike the growing gland, the radioactive phosphorus is not concentrated in the peripheral area or in the nipple.

These radioautographs are believed to represent mainly water-insoluble, organically bound phosphate. In a few rabbits that had been treated with lactogenic hormone, milk could be expressed from the glands, but the milk carried very little activity. Since milk normally has considerably more inorganic phosphorus than is found in blood plasma, there could have been very little phosphate in the intercellular compartment of these mammary glands. Lipid materials extracted with absolute alcohol or xylol likewise were relatively inactive, as were tissue exudates removed from the glands when they were drying under the heat lamp. Thus the bulk of the activity, insofar as these preliminary results indicate, was probably present in other organic linkages.

# *Comments and Communications*

## Multienzyme Systems

The recent book by Malcolm Dixon (*Multi-Enzyme Systems.* New York: Cambridge Univ. Press, 1949) places in print a logical framework of a rationalization for the existence of the phosphagens. The framework is Dixon's definition of phosphate potential and phosphate couples, with their corresponding rP scale, which is analogous to the rH scale for oxidation-reduction couples. Of course, since creatine phosphate exists in appreciable concentrations, it is a reservoir of high-energy phosphate. But why is it necessary to have another compound, in addition to the adenosine phosphate system, for the storage of high-energy phosphate?

In a medium as complex as protoplasm, it may be difficult to define experimentally the thermodynamic phosphate potential, even in a specific ultramicroscopic region of the protoplasm. Yet it seems clear that a low ratio of the concentration of adenosine diphosphate (ADP) to that of adenosine triphosphate (ATP), or simply a high concentration of ATP, is indicative of a high phosphate potential, and conversely.

If all the phosphate present in resting muscle as creatine phosphate were present as ATP, the phosphate potential would be much higher than actually exists. Furthermore, if the performance of other engines is analogous, the fully charged, high-potential system found in the moderately metabolizing tissue would be nearest to a state of equilibrium and would be the most efficient. Stress would not only lower the reserve of high-energy phosphate in the hypothetical system, but would also reduce the potential below its efficient level, and therefore the stress would compound itself.

Evolution has settled on concentrations of ADP and ATP that are quite low and of the same order of magnitude for moderately metabolizing systems. Whereas ATP reacts with a large variety of metabolites, creatine phosphate apparently only reacts with the adenosine phosphate system. Since the phosphate bond energy of creatine phosphate is somewhat lower than that of ATP, the ratio of ATP to ADP must be considerably lower than the ratio of creatine phosphate to creatine. This statement is in keeping with the knowledge that both ADP and ATP are intimately involved in the details of metabolism, whereas creatine apparently only stores energy in its phosphorylated derivative. In conditions of stress, much of the phosphate of creatine phosphate can be fed through the adenosine phosphate system without greatly altering the concentrations of its components. Thus the existence of phosphagen permits the maintenance of the most efficient levels of the active phosphorylated metabolites under conditions of both rest and stress. It is known that the ATP level of highly stimulated muscle does not seriously decrease until the muscle is exhausted, whereas the phosphagen decreases steadily. Thus it seems reasonable to infer that phosphagen is not only a storage depot for high-energy phosphate, but also is a buffer for the maintenance of the most effective levels of the components of the adenosine phosphate system under a wide variety of metabolic conditions. It is even possible that as phosphocreatine surrenders its phosphate to ADP, the free creatine is converted to creatinine, which process would conserve the ratio of phosphocreatine to creatine. This process would be extremely efficient as a buffering agent. The possible inability of organisms using phosphoarginine to destroy the arginine formed after transfer of its phosphate may be a measure of their lower state of development.

It may be that there are other metabolic double-couples, one active couple and one inactive, the inactive couple existing only to increase the span of conditions under which the most effective concentrations of the active couple can be maintained.

JAMES E. BACHER
*Public Health Service Research Fellow*
*of the National Institutes of Health,*
*at the Frick Chemical Laboratory*
*Princeton University, Princeton, New Jersey*

## Persistence of 2,4-D in Plant Tissues[1, 2]

Tullis and Davis discuss in a recent issue of SCIENCE, (111, 90, [1950]) the effect of supposedly persistent 2,4-D in plant tissues. They cite the effect described by Pridham (*6*) upon bean seedlings grown from seeds of plants sprayed with 2,4-D while the pods were maturing and that described by Dunlap (*3*) upon cotton seedlings grown from seed borne by plants that were injured the previous season by 2,4-D. They note, however, that Brown, Holdeman, and Hagood (*2*) report no evidence of injury on cotton plants grown from seed collected in "fields affected by 2,4-D."

The appearance of injury and of lack of injury to the new growth of two woody plants, Chinese tallow trees and chinaberry trees, respectively, the year following spraying with 2,4-D is also described. The authors state that "no other reports, to the writers' knowledge, have been published that would indicate any persistence of 2,4-D in plant tissues from one growing season to the next other than in seeds." They conclude that in the Chinese tallow trees "the 2,4-D had persisted[3] in the buds and other vegetative tissues of this plant from the time of injury" the previous season and that in the chinaberry trees it did

[1] This paper is based on work done for the Biological Department, Chemical Corps, Camp Detrick, Frederick, Md., under Contracts Nos. W-18-035-CM-168 and W-18-064-CM-237.

[2] Since this paper was written, H. B. Tukey (*Science*, **112**, 282 [1950], has discussed the same subject from a somewhat similar point of view.

[3] This use of the term "persisted" is different from that of publications of the Biological Department, Chemical Corps, Camp Detrick.

not "persist." Their evidence for the presence of the 2,4-D is in the "injury . . . on the earliest growth."

The 2,4-D may have been present in both the seeds and buds of these plants, but recent studies and observations indicate that, even though the 2,4-D be present, the observed effects on some seedlings and the Chinese tallow trees, and the absence of effect on the cotton seedlings grown by Brown, Holdeman, and Hagood and on the chinaberry trees may have another explanation.

Studies by Watson (*8*) on the bean plant, by the author on *Cyperus* (*4*), by Tukey on *Prunus* (*7*), together with observations of the effects of spray or dust treatment (sometimes accidental) on the spring growth of many woody plants, such as privet, rose, grape, and lilac, indicate that injury is done to the developing buds at the time of treatment but that the effect is evident only later when the buds develop. Whether the 2,4-D is still present—that is, "persists" or "is stored"—in the buds for a long time, even into the next growing season, has not as yet been determined so far as the writer knows. But the evidence from anatomy and ontogeny is that, whether or not the 2,4-D is still present, the injury is done at the time of the treatment and is brief, not continuing.

It has been known from the earliest anatomical studies of the effect of growth-regulating substances that the injury or stimulus is restricted to maturing tissues and to those mature tissues that readily awaken into meristematic activity, chiefly the endodermis and pericycle; and that the degree of injury depends upon the degree of maturity of the tissue or organ. In a developing bud, with leaves at various stages of maturity, there is a series in degree of injury to the immature leaves that is directly related to the stage of development of the leaves at the time of treatment. These degrees of injury are not evident at once in a bud that soon becomes dormant, except cytologically, but they become conspicuous when the bud resumes growth after the dormant period. The position of the series of injuries in the new growth can be controlled by the time of treatment of the mother plant (*8*).

The explanation of the apparently conflicting reports of injury and absence of injury after treatment lies in the relation of time of treatment to stage of bud development. This explanation covers not only the reports concerning the injury of the new growth of woody plants after dormancy following treatment, but also those of seedling studies in which the bud in the embryo, the plumule, is or is not affected, dependent upon its stage of development when treated. To understand the results of the treatment of any plant (position and type of injury), it is necessary to know the story of its bud development: number of leaves present in the bud at all stages (this may vary considerably); uniformity of stages in the series of leaves (in the bean plumule, for example, the series is not uniform because the two primary leaves are advanced at all stages far beyond the succeeding trifoliolate leaves); the time of plumule development in the seed or of bud development in the growing season—for example, June, or September–October.

The examples of apparent persistence of 2,4-D cited by Tullis and Davis can probably be explained as follows:

Pridham sprayed bean plants "during the ripening of pods"—that is, while the seeds were maturing and the embryos developing. The plumular leaves were affected, but the injuries did not appear until seedlings were grown from the seeds. Muratti (*5*) repeated Pridham's experiment and obtained results similar to those of Pridham. He showed that the extent and location of the injury varied with the size of the pod at time of treatment—that is, with stage of plumule development.

The conflicting reports concerning the effect upon cotton seedlings can be similarly explained, at least in part. Where no effect was noted, the treatment was probably given at a time when no bolls were developing (embryos would be injured only when bolls were developing), or was so severe that all immature bolls were abscised. Bolls developing from flowers present at time of treatment, or formed after time of treatment (even on severely injured plants), would not be expected to produce injured seeds, if the theory of brief effect is sound. Dunlap reports such injury from seeds "which were picked in September from bolls that were formed several weeks after the original damage occurred." Experiments to check this should be made. Some bolls in early stages may have been present at time of injury to the plant, or some later injury may have occurred.

The injury to the spring growth of the Chinese tallow tree is an example of the commonly seen injury to woody plants affected by 2,4-D during the previous growing season. The time of development of the winter buds of this tree and the date of spray treatment doubtless coincided. In the example of the chinaberry trees, probably the winter buds were mature, or nearly so, before the treatment or were very young; or perhaps the twigs bearing these buds were killed by the treatment. Adventitious buds developing the next spring would not show injury unless they were already partly grown at time of treatment.

Tullis and Davis state that the fact that "no symptoms of 2,4-D injury to chinaberry trees were found in 1949" on trees that were severely injured in this way in 1948 "indicates that 2,4-D does not persist in the vegetative tissues of this plant." This absence of injury indicates, in the writer's opinion, merely that there were no developing buds on the trees when they were sprayed and that, if there were mature buds present, they were killed by the severe treatment given the trees.

### References


1. Brown, C. A. (Abstr.) *Am. J. Bot.*, **34**, 20a (1947).
2. Brown, C. A., Holdeman, Q. L., and Hagood, E. S. *La. Bull. No. 426* (1948).
3. Dunlap, A. A. *Phytopath.*, **38**, 638 (1948).
4. Eames, A. J. *Am. J. Bot.*, **36**, 571 (1949).
5. Muratti, J. "An Anatomical Study of Foliage Modification of Red Kidney Bean Plants as a Result of Treatment of the Pods of the Preceding Generation, and of Mature Seeds, with 2,4-D." Cornell Univ.: Unpubl. thesis, 1949.
6. Pridham, A. M. S. *Science*, **105**, 412 (1947).
7. Tukey, H. B., and Krishnamurthi, S. (Abstr.) *Am. J. Bot.*, **36** (1949).
8. Watson, D. P. *Am. J. Bot.*, **35**, 543 (1948).



Arthur J. Eames

*Department of Botany*
*Cornell University, Ithaca, New York*

# *Association Affairs*

## The Cleveland Meeting, December 26–30, 1950

## IV—The Programs in Geology, Geography, Engineering, and the Social Sciences

THE following programs in the fields named in the heading constitute a fourth portion of the advance information on the 117th Meeting of the Association. Part I—**The Annual Science Exposition**, Part II—**The Programs in Mathematics, Physics, Astronomy, and Chemistry** (in part), and Part III—**The Programs in Biology and Medicine**, appeared in SCIENCE for October 27, November 3, and November 10.

PROGRAM OF SECTION E—GEOLOGY AND GEOGRAPHY

**Session 1.** Wednesday morning, December 27, *General Geology*, jointly sponsored by Section E and the Geological Society of America; Kenneth K. Landes, University of Michigan, chairman.

1. "Mineral Resources of Angola (Portuguese West Africa)." Richard J. Anderson, Battelle Memorial Institute.

2. "Beach Sands of the Mediterranean Coast of Egypt." Mohamed E. Hilmy, University of Michigan.

3. "A Dunite Ring Dike at Webster, North Carolina." G. Richards Gwinn, Alexandria, Virginia.

4. "A Catalogue of Rock Analyses." Charles S. Bacon, Jr., Case Institute of Technology.

5. "Time Relation of Magmatic Intrusion to Polymetamorphism at Preston, Connecticut." Charles B. Sclar, Ohio State University.

6. "Erosion Surfaces of the Adirondacks." G. H. Crowl, Ohio Wesleyan University.

7. "Pennsylvanian Sedimentation." Retiring Vice-Presidential Address. Raymond C. Moore, University of Kansas.

**Session 2.** Wednesday morning, December 27, *Geography*; Benjamin Moulton, Butler University, chairman.

1. "The Relationship of Permafrost to Agriculture in the Fairbanks, Alaska, Area." Troy L. Péwé, U. S. Geological Survey.

2. "Human Occupance on Lake Dakota Bed and Adjacent Moraine Topography." George D. Hubbard and Jewell A. Phelps, Oberlin College.

3. "Raised and Glacial Beaches on the West Shore of Lake Erie." William Gregory, Cleveland.

4. "A Giant Earth Mover." David G. Koch, Indiana State Teachers College.

5. "Postwar Changes in the Population of Poland." Bogdan Zaborski, McGill University.

6. "Terre Haute, Indiana, and its Environs." Thomas F. Barton, Indiana University.

**Session 3.** Wednesday afternoon, December 27, *General Geology*, jointly sponsored by Section E and the Geological Society of America; Raymond C. Moore, chairman.

1. "Geology as Science." G. Winston Sinclair, University of Michigan.

2. "New Discoveries Concerning the Sharon Conglomerate in Northeastern Ohio." J. Osborn Fuller, Ohio State University.

3. "Subsurface Study of Glacial Deposits at Cleveland, Ohio." C. T. Bagley, St. Louis.

4. "Lake Erie Geological Research Program." Howard J. Pincus, Ohio State University, and Gene Garrison, Ohio Geological Survey.

5. "Occurrence of the Middle Devonian Columbus Limestone near Ingersoll, Ontario." G. M. Ehlers and E. C. Stumm, University of Michigan.

6. "The Mineral City 'Structure'." Henry H. Gray, Kent State University.

7. "Subsurface Stratigraphic Sections across the Northern Part of the Appalachian Basin." Charles R. Fettke, Carnegie Institute of Technology.

8. "The Glacial Marine Limit in Maine." Richard J. Lougee, Clark University.

9. "A Glacial Water Plane in the Willimantic Valley of Connecticut." Adrian Vander Pyl, Clark University.

**Session 4.** Wednesday afternoon, December 27, *Geography*; M. D. Harbaugh, Lake Superior Iron Ore Association, presiding.

1. "Narvik, Norway: Swedish Ore Port." Lucile Carlson, Western Reserve University.

2. "The Geographical Structure of the Ohio Edison Company: A Privately Owned Electrical Public Utility System." James R. Beck, Kent State University.

3. "The Northernmost Spanish Frontier in California as Evidenced by the Distribution of Geographic Names." H. F. Raup, Kent State University.

4. "The Algoma Steel Plant: A Case Study in the Theory of Industrial Location." Carolyn W. Beck, Kent State University.

5. "Cincinnati Environs: Laboratory Opportunities for a Realistic Study of Physical and Cultural Geography." Melba P. Bowers, University of Cincinnati.

**Session 5.** Wednesday evening, December 27, *Program for Nonprofessionals, Part I*, jointly sponsored by the Geological Society of America; J. J. Schmidt, the East Ohio Company, Cleveland, chairman.

1. "Gaps in the Literature of Popular Geology." Mark W. Pangborn, Jr., Arlington, Virginia.

2. "Iron Ore for American Furnaces." M. D. Harbaugh, Lake Superior Iron Ore Association, Cleveland.

3. "Geology Program for Nonprofessionals." William E. Scheele, Cleveland Museum of Natural History.

4. "The Program of the American Geological Institute." David Delo, American Geological Institute.

5. "Information Services of the Ohio Division of Geological Survey." John H. Melvin, Ohio Division of Geological Survey.

Following this session, at 9:00 P.M., in the Grand Ballroom of the Carter Hotel, there will be a Geologists' Smoker.

**Session 6.** Thursday morning, December 28, Field Trip in the Cleveland Area, James R. Beck, leader.

**Session 7.** Thursday morning, December 28, *Program for Nonprofessionals, Part II,* jointly sponsored by the Geological Society of America; Glenn C. Tague, Western Reserve University, chairman.

6. "Geology of the Cleveland Region: Summary." Charles S. Bacon, Jr., Case Institute of Technology.

7. "Geology of Michigan." Helen M. Martin, Michigan State Geological Survey.

8. "Growing Rock Crystal." Danforth R. Hale, Brush Development Company.

9. "Some Geologic Features Observed in a Motor Trip through Africa." Henry F. Donner, Western Reserve University.

10. "A Geographer in Scandinavia." Lucile Carlson, Western Reserve University.

**Session 8.** Thursday morning, December 28, symposium on *The Implications of Nuclear Phenomena in Geology,* a joint program of Section E and Section B—Physics; Edward Teller, Institute of Nuclear Studies, University of Chicago, presiding.

(*Note*: For the details of this session, see **Session 3** of Section B in SCIENCE, November 3.)

**Sessions 9, 10, and 11.** A three-session symposium on *The Interrelations of Soil Science and Geology,* jointly sponsored by Section O—Agriculture, and Section E. *Part I,* Thursday afternoon, December 28; Richard Bradfield, Department of Soil Technology, Cornell University, presiding.

1. "Purpose and Scope of the Program." L. A. Wolfanger, Michigan State College.

2. "Distribution of Wind-deposited Soil Materials in the United States." James Thorp, U. S. Department of Agriculture, Lincoln, Nebraska.

3. "The Loess of Iowa and some Interrelations of Soils, Geology, and Geography." F. F. Riecken, Iowa State College.

4. "The Pleistocene Geology of Indiana." W. D. Thornbury, Indiana University.

5. "Pedological and Geological Connotations in Indiana." T. M. Bushnell, Purdue University.

*Part II,* Friday morning, December 29; M. M. Leighton, Illinois Geological Survey, presiding

1. "Pleistocene Studies of the United States Geological Survey and their Relation to Soils." C. S. Denny, U. S. Geological Survey.

2. "Soil-forming Intervals Evidenced in the Kansas Pleistocene." J. C. Frye, Kansas Geological Survey.

3. "Geological Classification of Alluvial Soils." S. C. Happ, Corps of Army Engineers, Kansas City, Missouri.

4. "Biotic and Climatic Associations of Buried Wisconsin Soils." L. R. Wilson, University of Massachusetts.

*Part III,* Friday afternoon, December 29; Richard Bradfield presiding.

1. "Applications of Geology and Soil Science to Highway Problems." A. E. Matthews, Michigan Highway Department.

2. "Relationships between Parent Material and Characteristics of Illinois Soils." R. T. Odell, University of Illinois.

3. "Influence of Wisconsin Glacial Stages in Northeastern Ohio on Soil Group Boundaries." G. W. White, University of Illinois.

4. "The Soils of Ohio." N. Holowaychuk, Ohio State University.

5. "Some Accomplishments and Some Problems Yet to be Solved." E. P. Whiteside, Michigan State College.

### NATIONAL SPELEOLOGICAL SOCIETY

The National Speleological Society, which became an associated society in Section E in 1949, will hold two sessions as follows:

**Session 1.** Thursday morning, December 28, William E. Davies, U. S. Geological Survey, presiding.

1. "An Aggregation of the Salamander, *Plethodon dixi.*" James A. Fowler, Philadelphia Academy of Natural History.

2. "The Zoogeography of North American Cave Snails." Joseph Morrison, Falls Church, Virginia.

3. "Notes on the Habits of the Long-eared or Lump-nosed Bat." Nancy G. Rogers, Army Medical Department Research and Graduate School, Washington, D. C.

4. "Notes on the Subterranean Accumulation of Saltpeter." Burton Faust, Washington, D. C.

5. "Speleological Photography in Advancing the Study of the Sciences." G. Alexander Robertson, Richmond, Virginia.

6. "A Remarkable Migration of Cave Salamanders." Charles E. Mohr, Audubon Nature Center, Greenwich, Connecticut.

**Session 2.** Thursday afternoon, December 28, Burton Faust, presiding

7. "The State Geologist Looks at Speleology." Paul Price, Geological Survey, Morgantown, West Virginia.

8. "Notes Concerning the Origin of Erratically Developed Cave Formations." William J. Foster, Arlington, Virginia.

9. "Erosion Levels in the Potomac Drainage System and their Relation to Cavern Development." William E. Davies.

10. "Research Possibilities in Speleology." Charles E. Mohr.

### NATIONAL GEOGRAPHIC SOCIETY

The annual lecture of the National Geographic Society, accompanied by a sound film in color, will be given on Wednesday evening, December 27, in the Music Hall of the Cleveland Public Auditorium. The speakers will be Dr. and Mrs. Matthew Stirling, the subject, the Archeological Expedition to Panama led by Dr. Stirling and sponsored by the National Geographic Society and the Smithsonian Institution. Kirtley F. Mather, President-elect of the AAAS, will preside.

PROGRAM OF SECTION M—ENGINEERING

**Session 1.** Tuesday afternoon, December 26, business meeting; Frank D. Carvin, Illinois Institute of Technology, and secretary of Section M, presiding.

**Session 2.** Tuesday evening, December 26, joint session of Section M and the Cleveland Section of the American Society of Mechanical Engineers; Roger W. Bolz, associate editor, *Machine Design*, presiding.

"What's New in Development Engineering?" M. A. Edwards, General Electric Company, Schenectady.

**Session 3.** Wednesday afternoon, December 27, joint session of Section M and Section K—Social and Economic Sciences, *Social Physics*; G. Edward Pendray, Pendray & Company, New York, presiding.

1. "What is Social Physics?" J. Q. Stewart, Princeton University.

2. "Dynamics of Economic Growth." W. F. Sutherland, Toronto Hydro-Electric System.

3. "Dimensional Analysis in Social Physics (with Testing of Gravitation Dimensions)." S. C. Dodd, University of Washington.

4. A discussion of the work of G. K. Zipf, recently deceased, and the paper he would have read on the American chemical industry.

**Session 4.** Wednesday evening, December 27, joint session of Section M and the Cleveland Engineering Society; John W. Greve, Associate Editor, *Machine Design*, presiding.

"Partners in Research." C. C. Furnas, Cornell Aviation Laboratory, Buffalo.

**Session 5.** Thursday afternoon, December 28, joint session of Section M and Case Institute of Technology; symposium: *The Human Body as a Factor in Engineering*; Elmer Hutchisson, Dean of the Faculty, presiding.

1. "Introductory Survey of Bio-Engineering." O. Glasser, Cleveland Clinic Foundation.

2. "The Human Body as a Limiting Factor in Aeronautical Engineering." A. P. Gagge, Medical Research Division, Office of the Surgeon General, HQ, USAF, Washington, D. C.

3. "The Human Body and Nuclear Engineering." R. D. Evans, Massachusetts Institute of Technology.

4. "Psychological Factors in Equipment Design." Walter Grether, chief, Psychological Branch, Aero-Medical Laboratory, Wright-Patterson AFB, Dayton.

5. "Health as Affected by Sanitary Engineering." G. E. Barnes, Case Institute of Technology.

**Sessions 6, 7, and 8.** Three-session symposium on *Partnership of Science and Engineering in Research*; K. W. Miller, Armour Research Foundation, Illinois Institute of Technology, general chairman.

*Parts I and II. Nuclear Engineering*; Irving P. Orens, Newark College of Engineering, presiding.

Friday morning, December 29.

1. "Nuclear Science in Engineering School Curriculum." W. B. Bartlett, U. S. Military Academy, West Point.

2. "Relations Between Nuclear and Electrical Engineering." Ernst Weber, Polytechnic Institute of Brooklyn.

3. "A Nuclear Engineering Course." Frank Maslam, New York University.

Friday afternoon, December 29.

1. "Recent Developments in the Treatment and Disposal of Radioactive Waste Liquors." C. P. Straub, Public Health Service, Oak Ridge National Laboratory.

2. "Problems in the Establishment of Maximum Permissible Radiation Exposure Levels." J. N. Stannard, University of Rochester.

3. "Prospect of Industrial Atomic Power." L. B. Borst, Brookhaven National Laboratory.

*Part III.* Friday evening, December 29; joint session of Section M and the Scientific Research Society of America; George A. Stetson, American Society of Mechanical Engineers, New York, presiding.

"The Partnership of Science and Engineering in Research." Eger Vaughan Murphree, president and director, Standard Oil Development Company.

PROGRAM OF SECTION H—ANTHROPOLOGY

One of the six sessions of Section H because of its content, is listed here; an outline of the other sessions will appear next week.

Session on *Government and the Administration of Native Peoples*, Friday afternoon, December 29; John Useem, Michigan State College, presiding.

1. "America's Dependent Minorities." A. Lesser, Association on American Indian Affairs, New York.

2. "Policing and Military Functions in South Asia." M. W. Smith, New York City.

3. "Some African Problems of Today." J. Comharie, Seton Hall College.

4. "United Nations Policy on Dependent Peoples." J. Harris, Division of Trusteeship, United Nations.

PROGRAM OF SECTION K—SOCIAL AND ECONOMIC SCIENCES

**Session 1.** The joint program with Section M—Engineering, *Social Physics*, Wednesday afternoon, December 27, noted above.

**Session 2.** Thursday morning, December 28, *Characteristics of the Urban Labor Force*, Charles Stewart, Bureau of Labor Statistics, U. S. Department of Labor, chairman.

1. "Maintenance vs. Production Functions of Cities over 100,000 Population." A. J. Jaffee, Bureau of Applied Social Research, Columbia University.

2. "Differentials in White and Non-White Participation in the Labor Force." Ralph Turner, Department of Anthropology and Sociology, University of California at Los Angeles.

3. "The Length of Working Life in American Cities." Seymour Wolfbein, Manpower and Productivity Division, Bureau of Labor Statistics. Discussants: Emmett H. Welch, National Security Resources Board; Edwin Goldfield, Bureau of the Census; and Robert J. Myers, Federal Security Board.

**Session 3.** Thursday noon, December 28, luncheon. *Planning for the Future of Section K*; Ernest W. Burgess, University of Chicago, chairman.

**Session 4.** Thursday afternoon, December 28, *Growth*

*of the Cleveland Area*, Paul Webbink, vice president, Social Science Research Council, and secretary, Section K, presiding.

1. "Factors Affecting the Development of the Cleveland Area." Jacob Baker and Henry Van Loon. Discussants: Mary C. Schauffler and Gale R. Ober, Jr.

**Session 5.** Thursday evening, December 28; symposium on *Viewpoints, Problems, and Methods of Research in Urban Areal Studies from the Standpoint of Different Disciplines*, James A. Quinn, University of Cincinnati, chairman.

1. "Biology." Charles C. Adams, New York State Museum, and Francis Evans, University of Michigan.

2. "Geography." Derwent Whittlesey, Harvard University, and Harold M. Mayer, University of Chicago.

3. "Demography." Gerald Breese, Bureau of Urban Studies Princeton University.

4. "Economics." Rutledge Vining, University of Virginia.

5. "Human Ecology." Amos H. Hawley, University of Michigan.

AMERICAN HOME ECONOMICS ASSOCIATION

The program of this society, with those in the fields of psychology and education, will follow next week.

NATIONAL ACADEMY OF ECONOMICS AND POLITICAL SCIENCE

The session Wednesday morning, December 27, is in collaboration with the National Social Science Honor Society, Pi Gamma Mu. Topic: *Industrial Research*; S. Howard Patterson, University of Pennsylvania, presiding.

1. "Basic Research in Industry." John A. Leermakers, Eastman Kodak Company.

2. "Governmental Contracts for Industrial Research." Thomas J. Killian, Office of Naval Research.

3. "Patents and Industrial Research." John A. Dienner, Brown, Jackson, Boettcher & Dienner, Chicago, Illinois.

PI GAMMA MU

The Annual Luncheon for the officers and speakers in Section K—Social and Economic Sciences, and the National Academy of Economics and Political Science, will be held Wednesday noon, December 27. A special guest of honor will be the Honorable Frank J. Lausche, Governor of Ohio.

RAYMOND L. TAYLOR
*Assistant Administrative Secretary*

# Scientific Book Register

***Comparative Animal Physiology.*** C. Ladd Prosser, Ed. Philadelphia: Saunders, 1950. 888 pp. $12.50.

***Plant Biochemistry.*** James Bonner. New York: Academic Press, 1950. 537 pp. $6.80.

***The Solubility of Nonelectrolytes.*** 3rd ed. Joel H. Hildebrand and Robert L. Scott. New York: Reinhold, 1950. 488 pp. $10.00.

***The Care and Breeding of Laboratory Animals.*** Edmond J. Farris, Ed. New York: Wiley; London: Chapman & Hall, 1950. 515 pp. $8.00.

***Mycotrophy in Plants: Lectures on the Biology of Mycorrhizae and Related Structures.*** Arthur P. Kelley. Waltham, Mass.: Chronica Botanica; New York: Stechert-Hafner, 1950. 223 pp. $4.50.

***Handbook of Freshwater Fishery Biology.*** Kenneth D. Carlander. Dubuque, Iowa: Wm. C. Brown, 1950. 281 pp. and appendix. $4.50.

***A Syllabus of Laboratory Examinations in Clinical Diagnosis.*** Thomas Hale Ham, Ed. Cambridge, Mass.: Harvard Univ. Press, 1950. 496 pp. $5.00.

***Organophosphorus Compounds.*** Gennady M. Kosolapoff. New York: Wiley; London: Chapman & Hall, 1950. 376 pp. $7.50.

***Iodine and Plant Life.*** Annotated bibliography 1813–1949 with a review of the literature. New York: Chilean Iodine Educational Bureau, 1950. 114 pp. No charge to agricultural scientists in the U. S. and Canada.

***Theory of Mental Tests.*** Harold Gulliksen. New York: Wiley; London: Chapman & Hall, 1950. 486 pp. $6.00.

***Antennas.*** John D. Kraus. New York: McGraw-Hill, 1950. 553 pp. $8.00.

***Vergleichende Physiologie: Hormone,*** Vol. IV. W. von Buddenbrock. Basle, Switz.: Verlag Birkhäuser, 1950. 492 pp. 47.50 Sw. fr.

***Conservation of Natural Resources.*** Guy-Harold Smith, Ed. New York: Wiley; London: Chapman & Hall, 1950. 552 pp. $6.00.

***Paradoxes of the Infinite.*** Bernard Bolzano; Donald A. Steele, translator. New Haven, Conn.: Yale Univ. Press, 1950. 189 pp. $3.75.

***Elements of Human Physiology.*** 2nd ed. Miriam Scott Lucas. Philadelphia, Pa.: Lea & Febiger, 1950. 357 pp. $4.75.

***Kinesiology.*** Laurence E. Morehouse and John M. Cooper. St. Louis, Mo.: Mosby, 1950. 435 pp. $4.50.

***Organic Chemistry.*** 2nd ed. Louis F. Fieser and Mary Fieser. Boston: Heath, 1950. 1125 pp. $7.50.

***The Properties of Metallic Materials at Low Temperatures,*** Vol. 1. Monogaph on Metallic Materials published under the authority of The Royal Aeronautical Society. P. Litherland Teed. New York: Wiley, 1950. 222 pp. $3.50.

***College Biology.*** William Etkin. New York: Crowell, 1950. 806 pp.

***The Evolution of Scientific Thought: From Newton to Einstein.*** 2nd ed. A. d'Abro. New York: Dover, 1950. 481 pp. $3.95.

***Annual Report of the Smithsonian Institution, 1949.*** Washington, D. C.: U. S. Government Printing Office, 1950. 422 pp. $2.75.

***Dairy Cattle and Milk Production.*** 4th ed. Clarence H. Eckles, Ernest L. Anthony, Rev. New York: Macmillan, 1950. 560 pp. $5.00.

# *News and Notes*

## The National Science Board

On November 2, President Truman announced his appointments to the twenty-four-man board of the National Science Foundation. The appointments must still be confirmed by the Senate. One of the first duties of the board will be the nomination of a director, whose appointment, however, is the prerogative of the President. The Foundation will start its work with the meager $225,000 allotted it just before the Congress recessed for the election. The complete list of appointees follows.

*Sophie B. D. Aberle*, Division of Medical Science, National Research Council

*Chester I. Barnard*, director, National Bureau of Economic Research, Inc.

*Robert P. Barnes*, associate professor of chemistry, Howard University

*Detlev W. Bronk*, president, The Johns Hopkins University, and president, National Academy of Sciences

*Gerty T. Cori*, professor of biological chemistry, Washington University Medical School

*James B. Conant*, president, Harvard University

*John W. Davis*, president, West Virginia State College

*Charles Dollard*, president, Carnegie Corporation of New York

*Lee DuBridge*, president, California Institute of Technology

*Edwin B. Fred*, president, University of Wisconsin

*Paul M. Gross*, dean of the Graduate School, Duke University

*George D. Humphrey*, president, University of Wyoming

*O. W. Hyman*, dean of administration, Memphis Division, and dean of College of Medicine, University of Tennessee

*Robert F. Loeb*, director of medical service, Presbyterian Hospital, New York, and professor of medicine, Columbia University

*Donald H. McLaughlin*, chairman, Advisory Committee on Raw Materials, Atomic Energy Commission, and president, Homestake Mining Co.

*Frederick A. Middlebush*, president, University of Missouri

*Edward L. Moreland*, executive vice president, Massachusetts Institute of Technology

*Joseph C. Morris*, vice president, Tulane University, and head of Department of Physics

*Harold Marston Morse*, professor of mathematics, Institute for Advanced Study, Princeton

*Andrey A. Potter*, dean of Engineering Schools and director, Engineering Experiment Station, Purdue University

*James A. Reyniers*, director, Bacteriological Laboratories, University of Notre Dame

*Elvin C. Stakman*, chief, Division of Plant Pathology and Botany, University of Minnesota

*Charles Edward Wilson*, president, General Electric Company

*Patrick H. Yancey*, head, Department of Biology, Spring Hill College

The National Science Foundation Act instructed the President to appoint a National Science Board of twenty-four members who "(1) shall be eminent in the fields of the basic sciences, medical science, engineering, agriculture, education, or public affairs; (2) shall be selected solely on the basis of established records of distinguished service; and (3) shall be so selected as to provide representation of the views of scientific leaders in all areas of the Nation." How well the President succeeded in this multidimensional problem is shown by the following analysis of some of the more obvious characteristics of the twenty-two men and two women whom he appointed.

1. *Fields represented.* Chemistry is the most frequently represented science, with three members. Engineering, medicine, physics, and physiology have two each. Bacteriology, biochemistry, biology, botany, geology, mathematics, plant pathology, and political science have one each. There are two foundation executives, two industrial executives, and one who specialized in education. Twenty of the twenty-four hold university appointments. No government employees were included. Industrial and working scientists, as distinct from administrators, seem to be underrepresented.

2. *Eminence.* Administrators predominate in the group. There are seven university presidents, four vice presidents, five deans, directors, or chairmen of university divisions or departments, one research director, and three professors. The universities they represent are private, public, large, small, Catholic, Protestant, nondenominational, Negro, and white. The four nonuniversity members are the presidents of two large foundations and two industrial companies.

The median age is fifty-six. Eight are over sixty, and two are under forty-eight. Eight of the members belong to the National Academy of Sciences, and one, Gerty Theresa Cori, is a Nobel laureate. Fourteen are Fellows of the AAAS, including the retiring president, a past president, and a member of the Executive Committee.

3. *Geographic representation.* The regions of birth, education, and present residence of the members are shown in the accompanying table.

REGION OF BIRTH, EDUCATION, AND PRESENT RESIDENCE OF MEMBERS OF THE NATIONAL SCIENCE BOARD

| Region | Birth | Bachelor's degree | Highest earned degree | Present residence |
|---|---|---|---|---|
| North-Eastern | 7 | 5 | 9 | 7 |
| North-Central | 6 | 6 | 8 | 6 |
| South | 8 | 6 | 1 | 7 |
| West | 1 | 3 | 1 | 4 |
| Foreign | 2 | 1 | 2 | 0 |
| Unknown or none | — | 3 | 3 | — |

## About People

**Harry K. Bell** and **Donald C. Zeiger** have been added to the staff of the Department of Horticulture, Rutgers University, as instructors. **Harry C. Kohl** recently joined the department as extension associate professor of floriculture. He took the place of **Richard B. Farnham**, who is now executive secretary of the New York Horticultural Society.

**Alan D. B. Clarke**, of the Institute of Psychiatry, Maudsley Hospital, London, will not be able to carry out his plans for study at the University of Michigan and elsewhere in the United States. In accordance with the terms of a fellowship in social psychology recently awarded to him by the Rockefeller Foundation, he and his wife had been granted visitors' visas under Section 201 of the U. S. Information and Educational Exchange Act of 1948 and had expected to sail from England for New York on October 18. He learned on October 13 that all existing visas were suspended and that revalidation would be necessary. According to his own statement, "The following day we went to the Embassy and were there asked to swear an affidavit under the new regulations. This affidavit related to political matters which we felt were the individual's private concern, and we informed the Vice-Consul that we were not prepared to sign the document on principle. Revalidation of our visas was then refused."

An applied mathematician, **Leonard Greenstone**, of Brooklyn, N. Y., has joined the Department of Applied Physics at Stanford Research Institute. He will work on problems of shock waves and compressible flow and will supply general mathematical assistance to various department projects. Before joining SRI, Dr. Greenstone was an assistant professor at the University of California at Los Angeles.

The former director of research for Standard Brands Incorporated, **William R. Johnston**, has been appointed vice president in charge of research. Dr. Johnston started with the company in 1933 as research chemist at the Fleischmann Laboratories.

**Harold J. Magnuson** has been recently appointed a member of the World Health Organization Expert Advisory Panel on Venereal Infections and Treponematoses. Dr. Magnuson is the director of the Venereal Disease Experimental Laboratory of the USPHS and research professor of the Department of Experimental Medicine in the School of Public Health, University of North Carolina.

**A. E. Michelbacher**, associate entomologist of the Experiment Station of the University of California College of Agriculture, and **E. S. Ross**, curator of entomology, California Academy of Sciences, San Francisco, are conducting a comparative study of entomological problems in Peru and Chile with those of California. Of primary interest will be study and comparison of methods of insect control, and investigation of the habits and ecological requirements of destructive insects that might prove troublesome in California.

**James A. Rafferty**, for more than two years chief of the Department of Biometrics at the Air Force School of Aviation Medicine, Randolph AFB, Texas, has been named assistant for operations analysis at USAF headquarters in Washington, D. C.

**Edward C. Reifenstein, Jr.**, has been named director of the Research Institute of Oklahoma Medical Research Foundation. Dr. Reifenstein was formerly consultant and executive director of the Medical and Research Division of Ayerst, McKenna & Harrison, Ltd.

**G. W. Schneider**, formerly assistant professor in horticulture, Rutgers University, has joined the staff of the Department of Horticulture, North Carolina State College, as associate professor of horticulture in charge of the Pomology Division.

## Visitors

**Richard Becker**, professor of theoretical physics at the University of Göttingen, has been appointed visiting professor of physics at Carnegie Institute of Technology, where he will take part in a program of research on magnetism and low-temperature phenomena. Dr. Becker will also serve as theoretical consultant on the program of research in low-temperature physics, and will lead a series of seminars on statistical mechanics.

**M. G. Evans**, of the University of Manchester, is presenting a series of lectures on "Reaction Kinetics" in the Department of Chemistry, University of Notre Dame. The lectures, which began November 15, will be continued through December 13, 1950.

## Fellowships

The American Telephone and Telegraph Company has announced the availability of the **Frank B. Jewett Fellowships** in the physical sciences. These postdoctoral fellowships, including chemistry, mathematics, and physics, carry a grant of $3,000 to each fellow and an additional honorarium of $1,500 to the academic institution where the fellow pursues his research. Further information may be obtained from J. C. Boyce, Argonne National Laboratory, Chicago.

Women with the equivalent of a Ph.D. degree, carrying on research in the mathematical, physical, or biological sciences, who need financial assistance and give evidence of high ability and promise, are eligible for the 1951–52 **Sigma Delta Epsilon fellowships**. Applications should be made before *February 1;* blanks may be obtained from Dr. Mayme I. Logsdon, The University of Miami, Coral Gables 46, Fla. Announcement of the award will be made early in March.

Six predoctoral fellowships in the Departments of Chemistry and Chemical Engineering at Princeton University will be offered for the academic year 1951–52 by the **Textile Research Institute**. Successful candidates accepted by both the institute and the university will receive a stipend of $1,200, plus all fees for first- and second-year fellows; $1,800, plus fees, for the third year after successful performance in the Ph.D.

preliminary examinations. Programs of study are identical with those of other graduate students in the departments concerned except that the thesis research will be done at the institute's laboratories in Princeton. Further information and application blanks may be obtained from Dr. John H. Dillon, Director of Research, Textile Research Institute, Box 625, Princeton, N. J.

## Meetings and Elections

**The Indiana Academy of Science** elected the following officers at its annual meeting at Hanover College, November 2–4: president, W. P. Morgan, Indiana Central College; vice president, J. E. Switzer, Bloomington; secretary, W. A. Daily, Eli Lilly & Company; and treasurer, Frank Welcher, Indiana University Extension, Indianapolis.

**The National Standardization Conference** of the American Standards Association will be held at the Waldorf-Astoria in New York, November 27–29. Features of the meeting outlined in the preliminary program include a discussion of practical application of standardization to meet needs in industrial production and military procurement, a session sponsored by the Committee on Standardization, National Association of Purchasing Agents, a consumer clinic, and a conference of executives of organization members of the association.

**The American Society of Mechanical Engineers** will hold its annual meeting in New York at the Hotel Statler, November 27–December 1. The scope of the meeting encompasses the development of power, the design of machines, and the management of men for the exploitation of both. The 19th National Exposition of Power and Mechanical Engineering will be held in Grand Central Palace, concurrently with the meeting. On exhibit will be the newest products of engineering, highly specialized components of big power plants, and smaller units for individual power. "Air Cargo Day," sponsored jointly with the Institute of Aeronautical Sciences and the Society of Automotive Engineers, will include technical papers on air cargo developments, including aircraft and ground-handling facilities, and exhibits by major airlines and aircraft manufacturers.

The midwinter meetings of the **American Psychoanalytic Association** will be held at the Waldorf-Astoria in New York, December 7–10. Thursday, December 7, will be devoted to an all-day meeting of the executive council; the Board on Professional Standards will meet all day Friday; the business meeting of the members will be held on Saturday morning; and Saturday afternoon and Sunday will be devoted to scientific sessions, which will include panel discussions as well as individual papers.

**The Division of High-Polymer Physics of the American Physical Society** will hold its eighth meeting in Chicago, November 24–25, at the University of Chicago and the Museum of Science and Industry. A feature of the meeting is a symposium on "Solidification and Crystallization in Polymers," presented in conjunction with a related symposium of the Division of Solid-State Physics, which is also meeting in Chicago.

## Colleges and Universities

**Cornell University** has established the William F. E. Gurley Fund in Paleontology, in the Department of Geology, for the "furtherance of the study of paleontology by prizes, scholarships, technical publications, collections or otherwise." Named after the noted geologist, who died in Chicago in 1943, the fund is based on a gift of $75,000 which he made to the university for this purpose.

**The University of California's** new Cancer Research Genetics Laboratory, located on the Berkeley campus, is functioning as a vital link in the university's state-wide cancer research program. The threefold objective of the laboratory includes carrying out a research program in the field of cancer genetics, providing appropriate animals for experimental work in all university cancer research programs, and serving as a clearinghouse of information and techniques in cancer genetic research for workers in other departments. At present located in the old Veterinary Science Building, the laboratory will eventually be housed in specially designed quarters provided for by legislative appropriation. Kenneth B. DeOme, associate professor of zoology, is director of the laboratory.

The U. S. Public Health Service has renewed the following grants: To Ruth E. Miller, $5,448 for one year for "A Study of the Effect of Immune Reactions on the Metabolism of Bacteria"; to Harold T. Freeman the sum of $2,500 for a year for (1) "Determination of Ascorbic Acid Content of Gastric Juice, Sputum, Urine and Blood in Patients with Known Organic G.-I. Disease"; (2) "Similar Determinations in Normals before and after Vitamin C Saturation"; and to Harold L. Israel a new grant of $8,661 for a two-year period for "Endocrinological Study of Patients with Sarcoidosis." All research will be done at the **Woman's Medical College**, Philadelphia.

**The University of Pittsburgh's** new Graduate School of Public Health, made possible by a gift of $13,600,000 from the A. W. Mellon Educational and Charitable Trust, opened at the beginning of the current term. Degrees of Doctor of Public Health and Master of Public Health will be awarded to physicians, nurses, sanitary engineers, dentists, bacteriologists, and workers in allied fields. Special study and research in occupational and industrial health and hospital administration are also offered. A health district is being established in the Lawrenceville area of Allegheny County as a practice field for students. The school, now a part of the University Medical Center, expects to have a Department of Physiological Hygiene in operation by 1951.

**The Instituto de Nutrición de Centro America y Panamá, Guatemala,** recently celebrated its first anniversary with an open house and a presentation of a scientific program. In addition to field teams in each member country, consisting of

a physician, a nutritionist, a hematologist-parasitologist, and a nurse, the institute in Guatemala has active programs in food analysis, hematology-parasitology, and clinical chemistry, microbiology and immunology, blood vitamin analyses, serum protein studies, and amino acid chromotography in urine and foods. This institute, sponsored by the Pan American Sanitary Bureau, World Health Organization, is directed by Nevin S. Scrimshaw. Reprint exchanges are especially requested.

The first known safety program of its kind, aimed at protecting research workers in campus laboratories from the hazards of radiation, has been launched at **Ohio State University**. The venture was established to help solve the problems created by the steadily mounting use of radiation-generating machines and radioactive materials in the university's research projects. Lester R. Rogers, who has been especially trained in health physics, is superintendent of the new safety program. He will be responsible for establishing safety measures in all areas of research and study in which generating machines and radioisotopes are used, and will keep records of the receipt and distribution of radioisotopes, make systematic surveys of the laboratories in which they are used, maintain records of blood counts of exposed persons, and check methods of disposal of radioactive waste materials.

New appointments in the department of Anesthesiology at the **Woman's Medical College**, Philadelphia are Hrant Stone, associate professor and chairman of the department; William Tudor Price, associate; Mary Gray Holderman, clinical assistant, Department of Anatomy; and Jean MacCreight, assistant professor.

**Yale University** astronomers have finally brought to a close one of the most intensive photographic mapping jobs ever undertaken by a single observatory, after half a million measurements and 23 years of work. Ida Barney, research associate in astronomy at Yale Observatory, has been honored for the task she began in 1927 under the sponsorship of the late Frank Schlesinger, former director of the observatory. Computations of the measurements made fill 13 volumes, and the number of stars measured amounts to more than 128,000. The mapping covered the sky from 30° south of the celestial equator to 30° north. The proper motions of the stars were determined by comparing the results of this study with those recorded more than 50 years ago. Participating with Yale in the work were Lick Observatory, Naval Observatory, the Greenwich Observatory, and the Cape of Good Hope Observatory. The greater number of photographic plates were made at the Yale-Columbia Southern Station, at the University of the Witwatersrand, Johannesburg, South Africa.

## Industrial Laboratories

Adrian Kameraad has been added to the staff of **Kremers-Urban Co.**, Milwaukee, as director of research. He was formerly scientific director of Van Patten Pharmacal Company in Chicago and instructor in anatomy in Northwestern University Medical School. Ralph Lubnow has joined the staff as control chemist.

A new price list of more than 2,400 organic chemicals has been published by **The Matheson Company**, East Rutherford, N. J. The list contains the regular line of chemicals plus several hundred new compounds. Copies are obtainable on request.

**Merck & Co., Inc.** has announced that cortone soon will be made generally available through distributors, hospitals, institutions, and pharmacies for use by the physician in his daily practice. A further price reduction is effective immediately. The suggested list price to physicians is $35 a gram.

**Sharp & Dohme, Inc.**, Philadelphia, has announced the appointment of Harold V. Darnell as commodity analyst. A former vice president of the American Pharmaceutical Association, Mr. Darnell was also assistant to the secretary and editor of the Practical Pharmacy edition of the *Journal of the American Pharmaceutical Association.*

## NRC News

At the end of its first year of operation, the **NRC Committee on Problems of Alcohol** has under its auspices 6 projects for research and education in the general field of alcoholism. These projects are being carried out by: the Chicago Committee on Alcoholism, at the University of Nebraska School of Pharmacy and the Elgin (Ill.) State Hospital; the Cornell University Medical College–New York Hospital, an investigation into the causes of chronic alcoholism, directed by Oskar Diethelm; New York University–Bellevue Medical Center, a study of biochemical and endocrinological aspects of alcoholism, directed by James J. Smith; New York University School of Education, a course in alcohol education by Morey R. Fields and Jay B. Nash; Biochemical Institute of the University of Texas, studies in metabolic factors in the etiology of alcoholism, directed by Roger J. Williams; and the University of Washington, studies on the allergic factor in chronic alcoholism, directed by Walter L. Voegtlin.

The committee is inviting investigators to submit research proposals concerned with the action of alcohol on human beings or animals, and it will attempt to find financial support for those projects it approves. Some of the areas of research that the committee feels need further study are the action of alcohol in furnishing energy, and the resulting reaction products; the action on the nervous system; unusual psychological reactions; and the various effects of alcohol on the physiological and psychological performance of susceptible persons.

The Chemical-Biological Coordination Center of the National Research Council announces the publication of a chemical code developed by the members of its Chemical Codification Panels and staff. The title of the 98-page booklet is ***A Method of Coding Chemicals for Correlation and Classification.*** The code was devised primarily to permit the use of

punched cards in the correlation of chemical structure with biological action. The booklet contains the rules and directions for coding organic and inorganic compounds; a listing of code symbols; a description of how the code can be used in connection with punched cards, including a brief description of machine operations; the punched-card layout; and about 200 examples of the coding of organic and inorganic compounds. Copies may be obtained from the Publications Office, National Research Council, 2101 Constitution Ave., Washington 25, D. C., at $1.50 per copy, postpaid. Checks or money orders should be made payable to National Academy of Sciences.

Three new compilations of geological information are now available from the American Geological Institute of the NRC: Report No. 2, ***The Earth for the Layman*** (50 pp., $1); Report No. 3, ***Non-Industrial Research in the Geological Sciences, 1950*** (80 pp., $2); and Report No. 4, ***Geological Guide Books and Road Logs in the United States*** (77 pp., $1).

***The Earth for the Layman*** is a selected list of books and pamphlets, mostly nontechnical, on geology, mining, rocks and minerals, gems, fossils, evolution, and related subjects, ranging from novels with a background of geological interest to instruction books for the amateur mineralogist or fossil collector. Many titles are annotated.

The report on nonindustrial research contains a listing of 3,000 research projects in progress in the U. S., Canada, and Mexico, grouped under 30 subfields of geology, and also, in many cases, by geographic area. The information includes the name of the researcher and his affiliation; title or brief description of the work; and the expected date of completion and place of publication.

Guidebooks and pamphlets that have been prepared by geological societies and other agencies are listed in Report No. 4. Since many of these contain information never before formally published, they represent often overlooked but valuable sources of areal geology. For each guidebook the report gives the title, area or route covered, date of publication, description of text and illustrations, disbursing agency, and whether now available and at what price.

***Human Factors in Undersea Warfare,*** a 540-page survey prepared by the Panel on Psychology and Physiology of NRC's Committee on Undersea Warfare, may be obtained from the NRC Publications Office for $2.25. The book summarizes present knowledge and research in several psychological fields, as well as their applications to the unusual conditions under which men live and work in a submarine. Parts of the survey consider general visual problems, including maps and charts, instruments, and radarscope visibility; design and arrangement of operating equipment; auditory problems, including sonar operation; communications, especially voice; physiological factors of habitability such as temperature, humidity, diet, and sleep; psychological factors of habitability such as noise, lighting and color, and motion sickness; emotional problems and stresses in a submarine crew; selection and training of men, particularly in military services; and personnel resources for research in applied experimental psychology. Each of the 24 chapters contains a bibliography.

## Deaths

The widely known mineralogist, petrologist, and authority on southwestern Ohio geology, **Otto C. von Schlichten**, died October 4 of a heart attack. He was 64. A University of Cincinnati graduate, he had served as Missouri State Geological Survey geologist as well as on the faculties of Lehigh University and Cincinnati.

**Clyde A. Malott**, 62, who retired in 1947 as professor of geology at Indiana University because of ill health, died in Bloomington, Ind., August 26, of a rare disease of the spleen. Dr. Malott was head of the Department of Geology and Geography from 1941 to 1945. He was an authority on geomorphology, and was well known as a student of underground drainage and caverns. He was also a foremost authority on the stratigraphy of the Chester series of the Indiana-Illinois Coal Basin and was a successful petroleum geologist, having found and developed his own oil field.

## Miscellaneous

The main dome of the largest and most modern observatory in France, **l'Observatoire de Haute Provence**, near Forcalquier (Basses Alpes), was dedicated October 1. Its telescope has a mirror 4 feet in diameter, with a magnifying power of 2,400. The apparatus weighs 7 tons but can easily be moved by hand. This observatory, which will eventually have three domes, is the main structure of an astronomical research center that includes ultramodern laboratories and precision-instrument workshops.

**The Department of Agriculture** has sent Clayton R. Orton, dean of West Virginia College of Agriculture, Forestry, and Home Economics, to Liberia, where he will make a study of agricultural development potentials. The assignment is one of the first to be made under legislation recently enacted by Congress to help underdeveloped areas accelerate their economic development and improve their standards of living. Dr. Orton's recommendations will serve as a guide to the U. S. government in giving technical assistance in developing the agriculture of the West African republic.

**The American Geographical Society** has just launched a new publication, *Focus*. The four-page information journal, to be issued monthy except July and August, will provide treatment of world problems and events in the news from the viewpoint of scientific geography. The entire first issue of *Focus* is devoted to a "Korean backdrop." Illustrated with maps showing physiographic features, land use and communications, mineral and power resources, and population distribution, the periodical illustrates the economic interdependence of north and south Korea. George H. T. Kimble, director of the society, has announced that forthcoming issues

of *Focus* will deal with such subjects as Russia's petroleum resources, the water problem of the U. S., strategic Iran, and other significant problems.

**Sharpe and Dohme** has developed a modified insulin—NPH Insulin—that increases stability and duration of the blood sugar lowering effect in treatment of diabetes mellitus. The new insulin, a combination of protamine and zinc-insulin crystals, can be substituted for regular insulin and usually requires only one dose daily. Dosage is determined individually for each patient.

The many common problems facing the supervisors of research animal quarters in medical schools and research institutions in the Chicago area have prompted the individuals concerned to form an organization, the **Animal Care Panel**, whose purpose is directed toward the solution of these problems. The first meeting will be held at Dora De Lee Hall, Lying-In Hospital, University of Chicago, on November 28. There will be no registration fee, and advance registration is not necessary. Further information concerning the group and its work may be obtained from Bennett J. Cohen, Supervisor, Animal House, Northwestern University Medical School, 303 E. Chicago Ave., Chicago 11.

In order to meet Australia's urgent need for increasing numbers of technologists and applied scientists, and to provide them with the means for advanced training and research, the Australian Parliament established **The New South Wales University of Technology** in April 1949. Ultimately to be governed by a council of thirty, consisting of representatives from Parliament, industry, commerce, trade unions, technical education bodies, professional organizations, the University of Sydney, and its own teaching staff and student body, the university provides courses leading to the Bachelor's degree in various applied sciences, and postgraduate courses leading to Master's and Doctor's degrees in science and engineering. Some short, special, intensive postgraduate courses not leading to higher degrees will also be provided. Students in most courses are required to attend classes for six months and to spend five months gaining practical experience in industry. Wallace Charles Wurth is chairman of the council and president of the university.

Representatives of the **U. S. Atomic Energy Commission** and the government of the United Kingdom are in Johannesburg, South Africa, holding discussions with Union authorities regarding the production of uranium from South African gold-bearing ores. The discussions are a continuation of those that took place in the Union a year ago. Representing the U. S. are Jesse C. Johnson, manager, Raw Materials Operations, AEC, Frank McQuiston, special advisor to Mr. Johnson, and A. A. Wells, special assistant to the AEC General Counsel.

**The National Registry of Rare Chemicals**, 35 West 33rd St., Chicago 16, submits the following list of wanted chemicals: phosphoryl fluorodichloride; sodium tetrametaphosphate; germanium difluoride; phosphonium sulfate; chromium carbonyl; 1,1,1-tribromoethane; tri-(*p*-isocyanophenyl)methane; 3-methylcoumarone; ω-hydroxydecanoic acid; 3,3-dichloropropene-1; heptacosane; 3-hexene-1-ol; 5-methylhexane-1-al; 1-methyl-4-methylol-glyoxaline; 1-methyl-4-methylol-imidazole; hexokinase, crystalline; myosin; sabinene; β-dimethylcholine; and primula acid.

**The Division of Neoplastic Diseases of Montefiore Hospital for Chronic Diseases** is presenting hourly conferences on the first and third Fridays of each month, in the hospital Social Hall. Alternate lectures are given by the hospital staff and are devoted to the presentation of interesting patients. Lectures by guest speakers are:

Dec. 1—"Genetics and Cancer," Clarence C. Little, Roscoe B. Jackson Memorial Laboratory.

Jan. 19—"Cancer of the Esophagus," John H. Garlock, College of Physicians and Surgeons, Columbia University.

Feb. 2—"Cytochemical Studies in Normal and Malignant Cells," Rudolph G. Leuchtenberger, Cleveland.

March 2—"Role of Research in Cancer," Howard B. Andervont, USPHS, Bethesda, Md.

April 6—"Hormonal Imbalances in Experimental Carcinogenesis," William U. Gardner, Yale University.

May 4—"Cancer of the Head and Neck," Hayes Martin, New York.

## Recently Received

***Experimental Studies on the Nature of Species. II. Plant Evolution through Amphiploidy and Autoploidy, with Examples from the Medinae.*** Carnegie Institution of Washington, Washington 5, D. C. $1.00 paper, $1.50 cloth.

***A Contribution to the Ornithology of Northeastern Venezuela.*** Herbert Friedmann and Foster D. Smith, Jr., Smithsonian Institution, U. S. National Museum, Washington 25, D. C.

***Bacteriological Proceedings, 1950.*** Society of American Bacteriologists, Baltimore, Md.

***Factors Regulating Blood Pressure.*** Trans. 3rd Conference May 5–6, 1949. Josiah Macy, Jr., Foundation, New York City.

***Bibliography on Sprays.*** Suppl. to Aug. 1948 ed. Kalman J. DeJuhasz and Wolfgang E. Meyer. Texas Company, Technical and Research Division, 135 East 42nd Street, New York City.

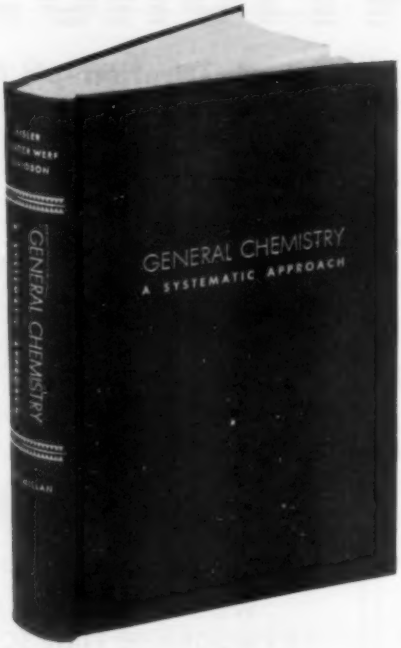
***Commonwealth Scientific and Industrial Research Organization: First Annual Report, 1948–49.*** L. F. Johnston, Commonwealth Government Printer, Canberra, Australia. 7s.9d.

***Nomads of the Long Bow: The Siriono of Eastern Bolivia.*** Allan R. Holmberg. Publ. No. 10, Institute of Social Anthropology, Smithsonian Institution, U. S. GPO, Washington 25, D. C. 65¢.

***Robert Boyle's Experiments in Pneumatics*** and ***The Overthrow of the Phlogiston Theory.*** James Bryant Conant, Ed., Harvard Case Histories in Experimental Science. Harvard University Press, Cambridge, Mass.

***Study of Diphtheria in Two Areas of Great Britain.*** Percival Hartley *et al.* Special Report Series 272, Medical Research Council. His Majesty's Stationery Office, York House, Kingsway, London. 4 s.

***Ticks (Ixodoidea) of the Philippines.*** Glen M. Kohls. Bull. 192, National Institutes of Health. U. S. GPO, Washington 25, D. C. 10¢.




# GENERAL CHEMISTRY

## A Systematic Approach

*By*

**Harry H. Sisler**
**Calvin A. Vanderwerf**
**Arthur W. Davidson**

"Designed primarily for the student who has a definite leaning toward a scientific career, but intended at the same time for the use of anyone taking a full year of general chemistry, this book assumes no previous work in chemistry for its understanding. Yet the material is in a form to challenge one who has had one or two chemistry courses in high school. Certain theoretical topics, such as phase diagrams, the determination of crystal structure, and the quantitative treatment of hydrolysis are omitted, while special attention is given to stoichiometric principles, to atomic and molecular structure, and to relationships based upon the periodic system." *The American Scientist*

THE MACMILLAN COMPANY
60 Fifth Avenue, New York, N.Y.

# Personnel Placement

**CHARGES and REQUIREMENTS for "PERSONNEL PLACEMENT" Ads**

1. **Rate:** 15¢ per word, minimum charge $3.00 for each insertion. If desired, a "Box Number" will be supplied, so that replies can be directed to SCIENCE for immediate forwarding. Such service counts as 10 words (e.g., a 25-word ad, plus a "Box Number", equals 35 words). All ads will be set in regular, uniform style, without display; the first word, only, in bold face type.

For ***display*** ads, using type larger or of a different style than the uniform settings, enclosed with separate border rules, the rate is $16.00 per inch; no extra charge for "Box Numbers".

2. **Advance Payment:** All Personnel Placement ads, ***classified*** or ***display***, must be accompanied by correct remittance, made payable to SCIENCE. Insertion can not be made until payment is received.

3. **Closing Date:** Advertisements must be received by SCIENCE, 1515 Mass. Ave., N.W., Washington 5, D. C., together with advance remittance, positively not later than 14 days preceding date of publication (Friday of every week).

## POSITIONS WANTED

**Bacteriologist:** B.S., recent graduate. Veteran, age 24. Desires opportunity leading to research. Eastern states preferred. Box 344, SCIENCE. X

**Bacteriologist-Chemist:** Experienced antibiotics, foods, diagnostic bacteriology. Seeks research—research development position requiring broad background. Box 345, SCIENCE. X

**Food Technologist:** M.S., Microbiology and Nutrition, considerable work toward Ph.D. (Food Technology); four years' teaching experience; past several years, director, research, food manufacturing company; for further information, please write Science Division, Medical Bureau, (Burneice Larson, Director) Palmolive Building, Chicago. X

**Microbiologist:** Ph.D. 27. Biochemistry minor. Desires university position with opportunity for research. West or midwest location desired. Box 342, SCIENCE. X

**Plant Pathologist:** Ph.D. 1950, Background Physiology and Microbiology. Desires academic or industrial position. Box 341, SCIENCE. X

**Position** with antibiotic culture maintenance responsibilities: thoroughly experienced in selections, creation of mutants, evaluation as to enzyme production. Well recommended. Box 343, SCIENCE. X



## POSITIONS OPEN

**Experimental Physicist or Astronomers:** Graduate degree or equivalent experience. Instrumentation work in Solar Astrophysics, Design or engineering experience necessary. Location, Boulder, Colorado. Box 340, SCIENCE. 11/24

**Large Industrial Company** in Midwest seeks Plant Physiologist or Biologist thoroughly conversant in Enzyme Chemistry for study of grain problems. Germination. Enzyme Development, etc. Excellent opportunity. Box 317, SCIENCE. R11/3; 11/17

**Positions Open:**
(a) **Immunochemist** interested in research in rheumatic fever and general field of allergy and, also, physiologist interested in pediatric research; large teaching hospital; university medical center, Midwest. (b) **Physician** qualified to do clinical research; large pharmaceutical company; responsibilities commensurate with qualifications. (c) **Bacteriologist or Microbiologist;** man of Ph.D. caliber required; modern air-conditioned research laboratories, large company engaged in producing water softener; Midwestern metropolis. (d) **Biochemist** to supervise department of chemistry in two hospitals, combined bed capacity 700; college town, East; around $7000. (e) **Medical editorial assistant;** one of the leading professional organizations. (f) **Chief bacteriologist;** duties consist of supervising routine bacteriologic diagnostic laboratories; opportunity for research, large teaching hospital; staff of 22; Midwest. (g) **Physiological chemist** to join research group, large industrial company; Master's degree desirable; Midwest. S11-3 Science Division, Medical Bureau (Burneice Larson, Director) Palmolive Building, Chicago. X

**Zoology:** Ph.D. Man under 35 years of age with experience and permanent interest in teaching elementary Zoology. Opportunity for advancement. Address inquiries to Chairman, Department of Zoology, University of Minnesota, Minneapolis, Minnesota. 11/24

# The Market Place

**CHARGES and REQUIREMENTS for "MARKET PLACE" Ads**

**1. Rate:** 20¢ per word for ***classified*** ads, minimum charge $5.00 for each insertion. Such ads are set in uniform style, without display; the first word, only, in bold face type.
For ***display*** ads, using type larger or of a different style than the uniform classified settings, and entirely enclosed with separate rules, rates are as follows:

| | |
|---|---|
| Single insertion | $16.00 per inch |
| 7 times in 1 year | 14.50 per inch |
| 13 times in 1 year | 13.00 per inch |
| 26 times in 1 year | 11.50 per inch |
| 52 times in 1 year | 10.00 per inch |

**2. Payment:** For all ***classified*** ads, payment in advance is required, before insertion can be made. Such advance remittances should be made payable to SCIENCE, and forwarded with advertising "copy" instructions.
For ***display*** advertisers, monthly invoices will be sent on a charge account basis—providing satisfactory credit is established.

**3. Closing Date:** Classified advertisements must be received by SCIENCE, 1515 Massachusetts Avenue, N.W., Washington 5, D. C., together with advance remittance, positively not later than 14 days preceding date of publication (Friday of every week).

For proof service on display ads complete "copy" instructions must reach the publication offices of SCIENCE, 1515 Massachusetts Avenue, N.W., Washington 5, D. C., not later than 4 weeks preceding date of publication.

## BOOKS



## PROFESSIONAL SERVICES

SUPPLIES AND EQUIPMENT

**QUARTZWARE**

for laboratory and industry

A complete line of standard laboratory ware. Also custom fabricating to meet your requirements. For particulars, write: *Quartzware Division*

**THE PANRAY CORP.**

340 Canal Street, New York 13, N. Y.

---

**LABORATORY ANIMALS**

- Clean healthy well-fed animals
- Guaranteed suitable for your needs.

Reasonably priced—Dependable service

DOGS RATS RABBITS
CATS PIGEONS HAMSTERS
MICE POULTRY GUINEA PIGS

JOHN C. LANDIS • Hagerstown, Md.

---

***ANIMAL CAGES AND ACCESSORY EQUIPMENT***

BUY DIRECT FROM MANUFACTURER

**HOELTGE BROS., Inc.**

1919 Gest St. Cincinnati 4, Ohio

*Write for 1950 Catalog*

---

**All Amino Acids** (natural, synthetic, unnatural), Rare Sugars, Biochemical Products, Reagents, New Pharmaceuticals in stock. Write or phone PLaza 7-8171 for complete price list

**BIOS LABORATORIES, INC.** 17 West 60th Street, New York 23, N. Y.

---

**WEATHER INSTRUMENTS**

Barometers • Thermometers • Psychrometers
Anemometers • Wind Vanes • Rain Gages

*send $.10 in stamps for catalog*

**SCIENCE ASSOCIATES**

401 N. BROAD ST., PHILADELPHIA 8, PA.

---

**PARASITOLOGICAL PREPARATIONS**

- high quality — low priced. *Write for catalog*

TROPICAL BIOLOGICALS • P.O. Box 2227, San Juan, Puerto Rico.

---

**RHEINBERGS RETICULES** *Established 1884*

MADE IN ENGLAND

Recently evolved secret processes of high resolution photography give accuracy and clarity hitherto unattainable, setting a new standard of perfection.

*Complete list of*
*EYEPIECE & STAGE MICROMETERS, ex stock, from*
RHEINBERGS LTD., 57/60 Holborn Viaduct, London E.C.1, England

---

**WHITE RATS 40c** and up

Rabbits, Cavies, White Mice, Ducks, Pigeons, Hamsters

*Write • J. E. STOCKER • Ramsey, N. J.*

The Market Place

SUPPLIES AND EQUIPMENT

**Cargille CHECK LIST**
of
**Laboratory Aids**
for
Industrial, Educational and Medical Laboratories

Second Edition Released November 1950

Write For Your Copy
Just Ask for Leaflet CK-2-S

**R. P. Cargille**

118 Liberty St. New York 6, N. Y.

---

*"Your animal is half the experiment"*

***SWISS ALBINO MICE***
***ALBINO-W RATS***

*albino farms* • P. O. BOX 331 RED BANK, N. J.

---

**STAINS**

STARKMAN Biological Laboratory

• RARE
• COMMON
*Price list on Request*
• 461 Bloor St., W. Toronto, Canada

---

SPRAGUE-DAWLEY, INC.

*Pioneers in development of the standard laboratory rat*

**Box 2071 • Madison 5, Wisconsin • Phone 36134**

---

**GLYCOCYAMINE—Hydroxyproline, L-Methionine**
• AMINO ACIDS • BIOCHEMICALS
• PRE-MIXED MICROBIOLOGICAL ASSAY MEDIA

**H. M. CHEMICAL COMPANY, LTD.**

144 North Hayworth Avenue Los Angeles 36, California

---

**• HYPOPHYSECTOMIZED RATS**

Shipped to all points via Air Express
For further information write

HORMONE ASSAY LABORATORIES, Inc. • 808 E. 58th St. Chicago 37, Ill.

---

***automatic* Washers**

for Pipettes • Animal Cages • Laboratory Glassware

*Please state your requirements*

**HEINICKE Instrument Corp.** • 315 Alexander St. Rochester 4, N. Y.

# HOTEL RESERVATIONS

## 117th AAAS MEETING

### Cleveland, December 26-30, 1950

The list of hotels and the reservation coupon below are for your convenience in making your hotel room reservation in Cleveland. Please send your application, *not* to any hotel directly, but to the Housing Bureau of the Cleveland Convention and Visitors' Bureau to avoid delay and confusion. The experienced Housing Bureau will make assignments promptly and the hotel will send a confirmation directly to you in two weeks or less. **Please plan to share a room with a colleague.** In addition to economy, this will insure ample accommodations for all in the *downtown* hotels. Mail your application *now* to secure your first choice of desired accommodations.

### HOTELS AND RATES PER DAY

| Hotel* | Single | Double | Twin-Bedded | Suites |
|---|---|---|---|---|
| STATLER | $4.00–$8.00 | $7.00–$10.00 | $8.50–$12.50 | $17.00–$23.00 |
| HOLLENDEN | $3.50–$8.00 | $5.50–$10.00 | $7.00–$12.00 | $12.00–$22.00 |
| CARTER | $4.00–$6.50 | $6.00–$10.00 | $7.00–$10.00 | $18.00–$25.00 |
| ALLERTON | $3.50–$7.00<br>$2.50 RW | $6.00–$ 9.00 | $6.00–$10.00<br>$4.00 RW | $10.00–$20.00 |
| AUDITORIUM | $3.50–$5.00 | $5.50–$ 7.50 | $7.50 | $12.50–$26.00 |
| OLMSTED | $3.00–$6.00 | $5.00–$ 9.50 | $7.00–$ 9.50 | $10.00–$15.00 |

**Prices are subject to change, but are not likely to do so.**
RW means running water only—no private bath.

* A list of the headquarters of each society and section is under **Association Affairs**, SCIENCE, August 25 and in THE SCIENTIFIC MONTHLY for September.

### THIS IS YOUR HOTEL RESERVATION COUPON

**Mrs. Louise D. Perkins, Director**
**Housing Bureau**
**Cleveland Convention and Visitors' Bureau, Inc.**
**511 Terminal Tower**
**Cleveland 13, Ohio**

**Date of Application** .....

Please reserve the following accommodations for the 117th Annual Meeting of the AAAS:

TYPE OF ACCOMMODATION DESIRED

Twin-Bedded..... Rate.....
Suite..... Rate..... Number in Party.....
Double Room..... Rate.....
Single Room..... Rate..... Sharing this room will be:
.....persons.....
*(Enumerate and attach list giving name and address of each person, including yourself)*

CHOICE OF HOTEL

First Choice..... Second Choice..... Third Choice.....

DATE OF ARRIVAL..... DEPARTURE DATE.....
(These *must* be indicated)

**SIGNED**.....
**(Please print or type)**

**ADDRESS**.....
(Street) (City and Zone) (State)

*Mail this now to the Housing Bureau.*
**Rooms will be assigned and confirmed in order of receipt of reservation.**
*Hotels will confirm directly in two weeks or less.*

# *Phosphors for* SCINTILLATION COUNTING

Example of the use of a solid plastic phosphor for coincidence counting with two photomultiplier tubes.




TRACERLAB now has available two versatile and highly efficient phosphorescent materials for use in scintillation detector units. One is synthetically grown stilbene crystal and the other is a new solid plastic phosphor. Single stilbene crystals up to one inch in any dimension are readily available and can be supplied in precisely machined forms.

The new solid plastic phosphor consists of a terphenyl solution in polystyrene. While plastic phosphors do not give as large pulses as stilbene, their primary advantage lies in the fact that they are available in a large variety of sizes and shapes and are considerably less expensive than crystalline phosphors. For further information write for bulletin S-30.

*Tracerlab*

**Western Division**
2295 San Pablo Ave., Berkeley 2, California
**New York Office**
General Motors Bldg., 1775 B'way, N. Y. 19
**Midwest Office**
LaSalle-Wacker Bldg., 221 N. LaSalle, Chicago

TRACERLAB INC., 130 HIGH STREET, BOSTON 10, MASS.